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THE INSECTS AND ARACHNIDS OF CANADA

PART 12

The Families and Subfamilies of Canadian Chalcidoid Wasps

Hymenoptera: Chalcidoidea

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Introduction

The superfamily Chalcidoidea, commonly called chalcids or chalcid flies, is a large group of mostly small parasitic or phytophagous insects within the suborder Apocrita of the Hymenoptera. It is an economically important group of insects, because most of the larvae eat insects, thus helping to control or suppress insect pest populations on forest and agricultural crops (Clausen 1940).

This superfamily is recognized as among the numerically largest insect groups and is an extremely diverse assemblage, united mainly on the structure of the pronotum and very reduced wing venation (Riek 1970). The chalcidoids now equal the number of described species of Ichneumonidae and are estimated at over 100 000 species by current workers. The number of world genera of Chalcidoidea has been estimated at 2000 (Noyes 1978). In America north of Mexico, there are about 2000 species known from 466 genera and 18 families (Bouček *in* Peck et al. 1964), or 11 families (Burks *in* Krombein et al. 1979). In Canada alone, there are about 380 genera and 800 species (Peck 1951, 1963; Burks 1958, 1967, 1979; Yoshimoto 1979).

The purpose of this manual is to assist amateur and professional entomologists, technical assistants, and students to recognize the families and subfamilies of chalcidoids, primarily through the use of illustrated keys. This book also contains a discussion and glossary of anatomical terms used in chalcidoid taxonomy, a section on general biology, and a discussion of the biology of each family and subfamily. Keys to the families and subfamilies are included. Subfamily treatments include a discussion of the tribes and genera known to occur in Canada.

Biology

Most female chalcidoids parasitize the eggs, larvae, or pupae of other insects and the eggs or juveniles of arachnids. Others feed on plant tissues of stems, leaves, seeds, or flowers, or stimulate the host plant to develop abnormal vegetative growths, called galls. Many are parasitic, and this behavior is distributed throughout the families of Chalcidoidea, with a few plant-feeding exceptions. The female searches for the host insect by the use of her olfactory, optical, and tactile senses. Chalcidoids are holometabolous. They develop through egg, larval, pupal, and adult stages. The egg is laid either outside or inside the host with the use of the ovipositor, which may be narrow and long as in the Torymidae or short and stubby as in the Eulophidae. Either the egg or the newly hatched larva may be deposited. The position and age of the host are important factors in the choice of host.

In some chalcidoids such as those of the family Eurytomidae, the larva feeds on plant tissues and it is frequently associated with galls on foliage and stems of many kinds of plants. In the family Torymidae, the members of the genus *Megastigmus* feed on plant seeds.

Parasitism is categorized on the basis of where the egg is laid and how the larva feeds. Most species attack the host directly, and the egg is either laid on the host and the larva develops externally (ectoparasitism), or deposited internally and the larva develops inside the host (endoparasitism) (e.g., family Eulophidae). The female eucharid and perilampid deposit the first-instar larva (planidium) directly onto the vegetation where the larva searches for hosts. In the eucharids, the planidium attaches itself to an ant worker and is carried into the nest. The eucharids are parasites only of larvae and pupae of ants. Certain families such as Mymaridae and Trichogrammatidae attack eggs of the host. Most aphelinids attack the nymphs of Homoptera. The torymids attack primarily the larvae in cecidomyiid and cynipid galls; others are secondary parasites on lepidopterous cocoons or dipterous puparia, and a few are phytophagous. Eulophids attack leaf-mining Coleoptera, Diptera, and Lepidoptera.

In the aphelinids, the development of the male and female in the reproductive phase is expressed by the following terminology. The situation in which females develop as primary parasites and males as secondary parasites on their own larval female is known as autoparasitism. When males develop as hyperparasites on females of their own species, this is known as obligate adelphoparasitism, and when males develop on females of different species, this is known as facultative adelphoparasitism. When the female maintains the direct, indirect, or primary relationship and the male becomes a secondary parasite on the female larva or pupa of the same species, this is known as obligate autoparasitism. Much of the reproductive behavior is dependent upon the mated or unmated condition of the female (DeBach 1964).

THE INSECTS AND ARACHNIDS OF CANADA

In the family Encyrtidae and in some species of Eulophidae, parthenogenesis is common. There are three types of parthenogenesis in chalcidoids, namely, arrhenotoky, deuterotoky, and thelyotoky. Most species of parasitic Hymenoptera exhibit facultative parthogenesis. The eggs may develop either parthenogenetically or zygogenetically, depending on the occurrence of fertilization. In the case of fertilized eggs (zygote), they are diploid and give rise to females, whereas unfertilized eggs (azygote) are haploid and give rise to males. This type of parthenogenesis is known as arrhenotoky. If the unfertilized eggs develop into both sexes (uniparental), this is known as deuterotoky. In obligatory parthenogenesis, each generation consists almost entirely of females, and this phenomenon is known as thelyotoky (DeBach 1964).

The host range of a species of chalcidoid varies from a single host species to a large number of species. Hence we may refer to monophagy (a parasite that lives on one host species), oligophagy (a parasite that lives on different species of the same genus), or pleophagy (a parasite that lives on species which belong to different but related families) (Bendel-Janssen 1977).

When the primary parasite becomes parasitized by another parasite, the condition is known as secondary parasitism, or hyperparasitism. The secondary parasitism may develop into tertiary parasitism, which, in turn, may develop into quarternary parasitism. The primary, secondary, or tertiary parasite, which may itself become a host, may either live in its primary, secondary, or tertiary host at the time it becomes parasitized or it may already have left the host for its own further development (Bendel-Janssen 1977).

The larvae of chalcidoids are minute, often only 0.2–0.5 mm long. The greatest variation in larval form occurs in the first-instar larva with 14 types (Clausen 1940; Hagen *in* DeBach 1964:179). The development thereafter (3–5 instars), tends to change to the usual hymenopterous type with a full complement of 10 spiracles, 12 or 13 visible segments, the greatest body width in the region of the thorax and first abdominal segment, and the lack of sculpturing, or segmented, processes on the first abdominal segment.

Detailed host lists are given in works by Peck (1963) and Burks *in* Krombein et al. (1979). A detailed discussion of the general biology of host–parasite relationships may be found in works by Clausen (1940) and Bendel-Janssen (1977).

Economic importance

The more important groups of chalcidoids, such as Aphelinidae, Eulophidae, Trichogrammatidae, Mymaridae, Encyrtidae, Eurytomidae, and Pteromalidae, are widely used in controlling or suppressing econom-

ic pest insects, both of forest and agricultural crops and those of public health importance. The use of these parasites is an important means of control alternate to chemicals, pathogens, or predators. The practice of integrated control using the above methods is being widely used to suppress target pests of great economic diversity, especially where chemical control measures are not feasible (DeBach 1964; Huffaker and Messenger 1976; Kilgore and Doutt 1967).

Distribution

Chalcidoids are found in all zoogeographical regions, in all terrestrial habitats except for oceanic islands and islands separated from the "continental mass." Despite the great abundance of numbers and species of chalcidoids, the taxonomy is poorly known (Gordh 1979).

Fossils

The oldest fossil records of Chalcidoidea are placed in the Cretaceous period (70–100 million years ago) (Yoshimoto 1975; Rasnitsyn 1980). The ancestral chalcidoids probably flourished about 100 million years ago. They are about half as old as the Xyelidae, the earliest hymenopterous fossils from the Lower Triassic period (Riek 1970). Because of their small size, most of the fossil chalcidoids are represented in amber material. These are placed in nine families with fewer than 70 species; they represent only a small fragment of the present chalcidoid fauna.

Classification

Superfamily diagnosis:

The superfamily Chalcidoidea contains moderately small (20 mm) to minute (0.2 mm) insects, many of which are either black or brilliant metallic green. Most of the species are parasitic or hyperparasitic on other insects, spiders, mites, or other arthropods. A few are phytophagous, some of them making plant galls (Ferrière and Kerrich 1958).

Within the Hymenoptera, adults of this superfamily are recognizable by the posterior margin of the pronotum touching the tegula, as in some species of Mymaridae and Mymarommatidae, or not touching the tegula (in the latter case, the pronotum is separated from the tegula by the prepectus (Fig. 5)); the anterior margin of the pronotum usually separated from the neck region by a carina; the venation of the fore wing reduced to a few veins (submarginal, marginal, postmarginal, and stigmal) (Fig. 6); the propodeum usually bearing plicae (lateral carinae) and a

median carina (Fig. 4); the prepectus occasionally reduced to a long, narrow projection as in Mymaridae or fused to the pronotum as in most eucharitids and perilampids (Figs. 48, 50). The chalcidoids are also the only Hymenoptera where the prothoracic spiracle is situated at or above the level of the tegula (Fig. 25).

Most species of the group have five-segmented tarsi, although the tarsi are three-segmented in the Trichogrammatidae, and four-segmented in most Eulophidae as well as in some Mymaridae, Aphelinidae, and Encyrtidae.

Many chalcidoids are active jumpers, the stronger ones using their middle legs, which are modified with enlarged tibial spurs and with dense padlike hairs and rows of spines for gripping the surface on the underside of the tarsus. The enlarged mesothoracic muscles evidenced by the inflation of the mesepimeron in such families as Encyrtidae and Aphelinidae are correlated with this ability to jump. The hind legs with enlarged hind femur seen in Elasminae (Eulophidae), Chalcididae, and some Torymidae and Pteromalidae are also used in jumping. The hind femur is toothed in at least some members of the last three of these families (Riek 1970).

In the recent classification of Chalcidoidea, Ashmead (1904) first proposed the use of 14 families. Nikol'skaya (1952) elevated this number to 24 families, and Bouček *in* Peck et al. (1964) and Graham (1969) reduced it to 18 families including the Mymarommatidae and the Tetracampidae. Riek (1970) recognized only nine families, and Burks *in* Krombein et al. (1979) recognized 11 families. The following have been treated by some authors as subfamilies: Leucospidinae (Chalcididae); Eupelminae, Signiphorinae, Aphelininae (Encyrtidae); Eucharitinae, Ormyrinae, Perilampinae (Pteromalidae); Agaoninae (Torymidae); and Elasminae (Eulophidae) (excluding Tetracampidae and Mymarommatidae).

In this manual, I am following the classification of Graham (1969), Burks *in* Krombein et al. (1979), and, in part, Bouček *in* Peck et al. (1964). The families and subfamilies seem to exhibit coherent morphological and phylogenetic relationships to form a natural grouping. The classification of higher taxa, however, depends upon the opinion of each worker with regard to weight placed on individual character states. The Canadian fauna includes all the Nearctic families with the exception of the Agaonidae. The treatment of families in this manual is arranged phylogenetically. Subfamilies appear in the sequence found in the keys.

Techniques

The chalcidoid wasps are difficult to identify unless the specimens are in good condition and properly mounted on points or on glass slides. The weakly sclerotized body often collapses during dehydration, which leaves them in a distorted state. Accurate descriptions, which are dependent on minute measurements, descriptions of shapes, or illustrations of species, are all subject to error because of the artifacts produced during the normal drying of specimens. The use of a critical point dryer (Gordh and Hall 1979), when the insect specimens are previously dehydrated in alcohol, will preserve a fully inflated "lifelike" appearance with bristles, antennae, and wings fully extended and specimens retaining their colors and degree of flexibility.

Medium-sized chalcidoids measuring 0.5–2.5 mm require magnification between 500 and 130× with a steroscopic microscope. A light diffuser (such as a sheet of matte-surface tracing film mounted on a stand) is held between the lamp and the specimen to view the detailed sculpture of the body. This method is useful in describing types of sculpture. Smaller specimens such as mymarids, trichogrammatids, and some eulophids may need to be slide-mounted for study at 200–500× on the compound microscope. Martin (1977) and Noyes (1982) illustrated various methods of preparing minute chalcidoids for museum study and permanent storage of specimens. The use of the scanning electron microscope is also useful where integuments must be examined in detail.

The chalcidoids are usually collected by the conventional sweep net method or reared from host insects. The insects collected in the sweeping net are placed in the "separation bag" and the target insects are aspirated from the bag without damage or loss (Masner and Gibson 1979). However, other collecting methods can be employed, such as Malaise, Berlese, pitfall, and pan traps, and gasoline-operated suction machines (Martin 1978; Noyes 1982). Wasps can be preserved in 70% ethyl alcohol or critical point dried in airtight vials as an alternative to permanent mounting. They can also be mounted directly on points when the specimens are freshly killed.

Anatomy

The terminology employed here is that of Graham (1959, 1969) and Richards (1956); other references include Hedqvist (1963), Snodgrass (1910, 1935), and Matsuda (1965, 1970).

Head (Figs. 2, 3). The compound eyes, which generally occupy the greater part of the side of the head, are the most obvious landmark. The ocelli, typically three, lie at the top of the head between the eyes in a more or less triangular arrangement. The central ocellus is the anterior (median) ocellus, and the outer ocelli are the posterior (lateral) ocelli. The

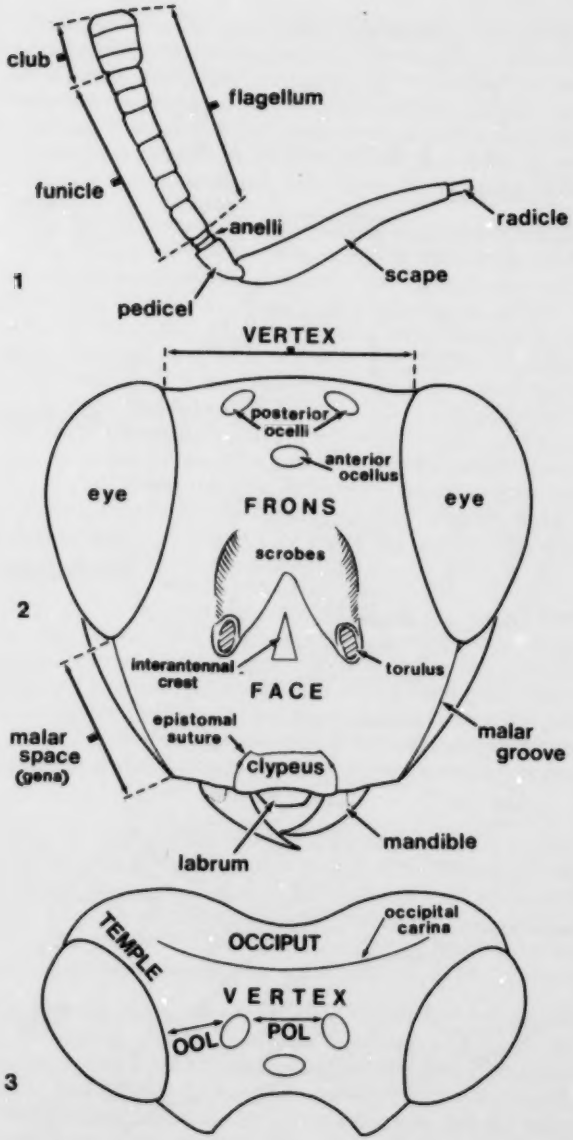
distance between the posterior ocellus and eye margin is the ocellar-ocular line (OOL), and the distance between the posterior ocelli is the postocellar line (POL). Behind the posterior ocelli there is usually a transverse carina, the occipital carina. The region of the head posterior to this is the occiput. The area of the head located between the occipital carina, the inner orbits (margins) of the eyes, and the anterior ocellus is the vertex, and the region posterior to the eye on either side of the vertex is the temple. The area between the ventral margin of the eye and base of the mandible is the gena, and the distance between the ventral edge of the eye and mandibular articulation is the malar space. Often a suture, the malar groove, is present.

The most obvious structures on the frontal aspect of the head are the antennae (Fig. 1). The antennal toruli are the sockets of the antennae (Fig. 2). The prominent carina between the toruli is known as the interantennal crest. The area of the head between the toruli, the inner orbits of the eyes, and the anterior ocellus is the frons (defined by Graham 1969), and the area between the toruli, the eyes, and the clypeal edge is the face (Fig. 2). The clypeus often is a poorly defined mesal region above the oral margin and demarked by the epistomal suture. The scrobes are one or two depressions often present on the frons in which the antennal scape lies at rest.

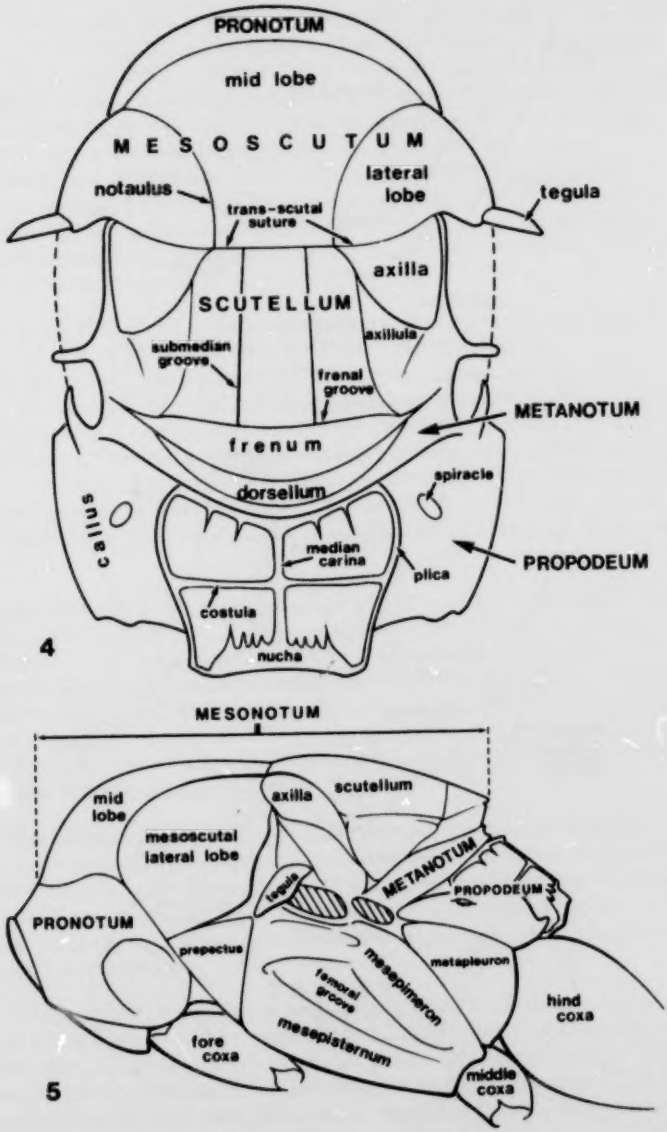
Antennae (Fig. 1). The antennae of chalcidoids consist of the scape, pedicel, and flagellum. A narrow, sometimes elongate, radicle (basal prolongation of scape) connects the scape to the head. The flagellum usually is multisegmented and in the female generally differentiated into 1–4 tiny anelli (ring segments), a funicle with 0–7 segments, and a club (clava) with 1–5 segments. The male antennae are branched (e.g., Eulophidae and Encyrtidae), and usually do not have a club differentiated from the funicle segments.

Mesosoma (Figs. 4, 5). The mesosoma, or true thorax, consists of three segments, the prothorax, mesothorax, and metathorax. Posterior to the metathorax is the propodeum, the first abdominal segment, which has become fused with the thorax. Because of its intimate fusion with the thoracic segments it is more convenient to consider the propodeum as part of the mesosoma.

The prothorax consists largely of the dorsal sclerite, the pronotum, which is variable in shape, an important distinguishing character at the family level. The lateral edges of the pronotum invariably are reflexed ventrally to cover most of the lateral part of the prothorax. The lateral metapleuron, like the mesopleuron, is usually separated into metapisternum and metepimeron by a metapleural suture.



Figs. 1–3. Terminology: 1, antenna; 2, frontal view of head; 3, dorsal view of head.



Figs. 4, 5. 4, dorsal view of thorax (after Graham 1969); 5, lateral view of thorax (after Graham 1969).

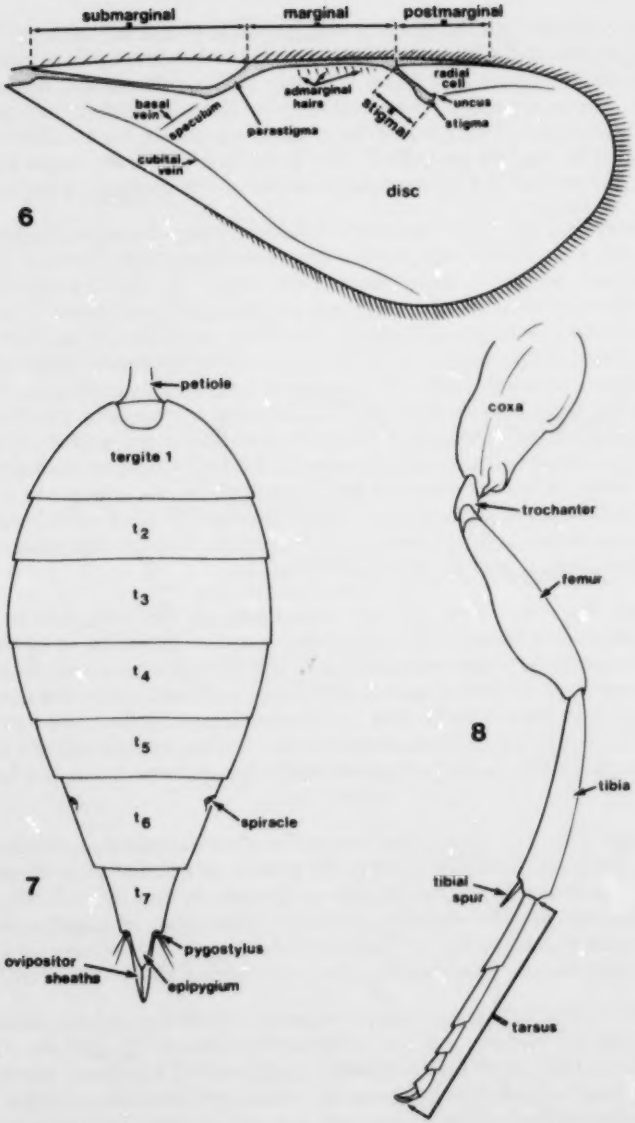
As noted previously, the first abdominal segment has become fused with the thorax and is known as the propodeum. It bears a pair of spiracles near its lateral edges and often a number of taxonomically important carinae. These are the median carina, plica (lateral carina), and costula (horizontal carina). The apex of the propodeum where it is attached to the gaster may be slightly projected; this projection is known as the nucha. The lateral area of the propodeum laterad of the spiracles is the callus.

Wings (Fig. 6). The venation of the fore wing of winged chalcidoids is reduced to a single composite vein, which generally consists of the submarginal, marginal, and postmarginal veins, and often a small stigmal vein projecting between the marginal and postmarginal veins. The stigmal vein often is expanded into a knoblike structure at its apex, the stigma, and this may have a hook, the uncus. The thickened region of the submarginal vein adjacent to the marginal vein is the parastigma. Other obsolescent veins may be indicated on the wing by ridges or hairlines, in particular the basal vein and cubital vein. The speculum, a bare region, is present posterior to the parastigma and bounded in part by the basal and cubital veins. A radial cell may be delineated by the stigmal vein and macrotrichia extending from the stigma toward the apex of the wing. A row of setae below and parallel with the marginal vein are the admarginal hairs. The central part of the wing is the disc.

Legs (Fig. 8). The legs are composed of the coxa, trochanter, femur, tibia, and tarsus. The trochanter is two-segmented in all chalcidoids except the Mymarommatidae in which the parts have coalesced into a single segment. The tibia apically has one or two tibial spurs; the number of spurs on the fore, middle, and hind legs is known as the tibial formula, e.g., 1-1-1, 1-1-2, 1-2-2. The tarsus is three- to five-segmented; the number of segments is an important distinguishing character at the family level.

Gaster (Fig. 7). The gaster comprises the abdominal segments posterior to the propodeum, including the petiole, which connects the gaster to the propodeum. In many chalcidoids the petiole may be reduced to an inconspicuous ringlike segment, broader than long, in which case the gaster is said to be "sessile." If, however, the petiole is relatively long and conspicuous, longer than broad, the gaster is said to be "petiolate."

There are seven gastral segments posterior to the petiole, although not all may be visible, and the ultimate segment is actually the fused remnants of the apical four abdominal segments. The dorsal sclerite of each segment is the tergite, whereas the ventral sclerite is the sternite. The penultimate tergite (t6) bears the only pair of functional spiracles on the gaster. The ultimate gastral tergite bears a small pair of fine hairs, the pygostyli (cerci). The apical segment also has a dorsal and ventral arch, the epipygium and hypopygium, respectively. In most females a pair of ovipositor sheaths, which protect the ovipositor when at rest, project from the apex of the gaster. The degree to which these project is an important distinguishing character for some families.



Figs. 6–8. 6, fore wing (after Graham 1969); 7, gaster (after Graham 1969); 8, hind leg (after Graham 1969).

Key to families of Chalcidoidea

1. Petiole 2-segmented (Fig. 87). Fore wings pedunculate and entirely reticulate (Figs. 89, 91). Antennal toruli close to each other at level of dorsal eye margins ..... **Mymarommatidae** (p. 127)

Petiole 1-segmented, or abdomen broadly attached. Fore wings if pedunculate not reticulate (Fig. 95). Antennal toruli distinctly separated from each other; if close to each other then ventrad to dorsal eye margins 2

2(1). Antennal toruli much nearer inner orbits of eyes than to each other except in subfamily Eubroncinae (Fig. 94); frons with transverse suture just above antennal toruli, with supra-orbital suture extending from either end of this along inner orbits of eyes (Fig. 94). Venation greatly reduced, with marginal vein short and stigmal vein rudimentary; stigmal vein usually not extending beyond middle of wing length (Figs. 93, 95) ..... **Mymaridae** (p. 130)

Antennal toruli not nearer to inner orbits of eyes than to each other; frons without transverse suture, though possibly with frontal fork. Venation usually more developed with distinct stigmal and postmarginal veins; stigmal vein usually extending beyond middle of wing length 3

3(2). Tarsi 3-segmented; body stout, 0.5–1.0 mm; postmarginal vein absent (Fig. 86); antennal funicle 0–2-segmented (Fig. 86); setae of fore wing arranged in longitudinal rows in a number of species ..... **Trichogrammatidae** (p. 125)

Tarsi 4- or 5-segmented; body slender, or if stout then body 1–5 mm; postmarginal vein rudimentary, slightly acute or elongate (Figs. 10, 44, 66, 72, 80); antennal funicle 0–7-segmented; setae of fore wing rarely arranged in longitudinal rows 4

4(3). Hind coxa huge, flat, platelike (Fig. 73); hind tibia often with rhomboidal pattern of setae (Fig. 73) ..... **Eulophidae** (in part) (p. 107)

Hind coxa typical or huge but not flattened (Figs. 19, 25, 33); hind tibia lacking rhomboidal pattern of setae 5

5(4). Gaster broadly attached, with basal segment as wide as propodeum (Fig. 32); propodeum with triangular median area; scutellum transversely ribbonlike ..... **Signiphoridae** (p. 53)

Gaster more narrowly attached, at most with basal segment at least slightly narrower than propodeum (Fig. 28), or petiolate; propodeum without triangular median area; scutellum rarely transversely ribbonlike 6

6(5). Hind tarsus 4-segmented 7

Hind tarsus 5-segmented 10

7(6). Winged forms with marginal vein shorter than broad or indistinct (Figs. 26, 30). Mesoscutum evenly convex, without notauli (Fig. 28). Mid coxae inserted at or slightly in front of middle of mesepisternum (Fig. 29) ..... **Encyrtidae** (in part) (p. 44)

Winged forms with marginal vein distinctly longer than broad (Figs. 44, 84). Mesoscutum with incomplete to complete notauli. Mid coxae inserted at or near hind end of mesepisternum 8

8(7). Gaster sessile, with base of gaster almost as broad as propodeum. Fore wing with stigmal and postmarginal veins reduced, indistinct (Fig. 84). Body not metallic in color. Scutellum lacking submedian grooves ..... **Aphelinidae** (in part) (p. 121)

Gaster petiolate (Figs. 47, 72, 83). Fore wing with stigmal and postmarginal veins distinctly developed. Body usually partly metallic in color. Scutellum usually with submedian grooves (Figs. 4, 78) 9

9(8). Antenna 11- or 12-segmented, with 6 funicle segments. Propodeum with at least several hairs on median third, these inclined toward midline (Fig. 72) ..... **Tetracampidae** (in part) (p. 104)

Antenna with at most 10 distinct segments and 2–4 funicle segments (Figs. 73, 83). Propodeum with median third not hairy ..... **Eulophidae** (p. 107)

10(6). Hind femur with ventral edge serrate (Fig. 15), or with one or more distinct teeth (Fig. 9), usually strongly swollen (Figs. 9, 10, 12) 11

Hind femur without serrations or teeth, not swollen 14

11(10). Gaster striped yellow and black with dense thimblelike punctations. Fore wing longitudinally folded as in vespoid wasp. Female with ovipositor recurved over dorsum of gaster (Fig. 9) .... **Leucospidae** (p. 27)

Gaster not striped yellow and black and finely sculptured, except for thimblelike punctations in Ormyridae. Fore wing not folded longitudinally as in vespoid wasp. Female with ovipositor slightly protruding from gaster or at least not recurved over gaster 12

12(11). Prepectus invisible or represented by small, inconspicuous plate near tegula (Fig. 10). Body not metallic in color, usually black or with white, yellow, or red markings. Thorax coarsely sculptured ..... **Chalcididae** (p. 29)

Prepectus large and conspicuous (Fig. 19). Body usually metallic in color. Thorax usually finely sculptured 13

13(12). Inner margins of eyes diverging strongly ventrally. Antennae inserted below ventral margins of eyes (Figs. 52, 58) ..... **Pteromalidae** (in part) (p. 75)

Inner margins of eyes at most only slightly diverging ventrally. Antennae inserted at least slightly above ventral margins of eyes (Fig. 19) ..... **Torymidae** (in part) (p. 36)

14(10). Mesopleuron greatly enlarged and swollen (Figs. 29, 35). Mid tibial spur large and thickened (Fig. 35); basal segments of mid tarsus of females thickened, and at least first segment with two rows of short, stout ventral spines (Fig. 35) 15

Mesopleuron not enlarged and swollen (Fig. 39). Mid tibial spur usually not thickened and without ventral spines (Fig. 53); basal segments of mid tarsus of female not thickened, and segments without spines above 16

15(14). Mid coxae inserted at about middle of mesopleuron. Gaster straight (in dried specimens) and commonly short and stout. Mesonotum usually evenly convex (Fig. 29), though rarely with linear notauli; winged forms with marginal vein usually short or obsolete (Figs. 26, 30) .. **Encyrtidae** (in part) (p. 44)

Mid coxae inserted at or behind posterior end of mesopleuron (Figs. 33, 35). Gaster usually elongate, characteristically U-shaped in dried specimens. Mesonotum broadly depressed at least posteriorly (Fig. 36); winged forms with marginal vein longer (distinctly longer than stigmal vein) ..... **Eupelmidae** (in part) (p. 54)

16(14). Prepectus fused with and lying in same plane as lateral part of pronotum. Thorax usually high and short as seen in lateral view (Figs. 48, 50). Gaster usually with tergites 1 and 2 more or less concealing posterior ones 17

Prepectus not fused with and not lying in same plane as lateral part of pronotum. Thorax usually not high and short as seen in lateral view. Gaster usually with more than two visible tergites 18

17(16). Pronotum clearly visible in dorsal view, though narrow (Fig. 49). Mandibles not sickle-shaped. Petiole usually short, transverse, at most twice as wide as long. Gaster characteristically triangular (Fig. 49) ..... **Pteromalidae** (in part) (p. 75)

Pronotum not visible in dorsal view, hidden by strongly convex mesoscutum (Fig. 47). Mandibles sickle-shaped (Fig. 46). Petiole longer than broad, often considerably so. Gaster characteristically rudder-shaped (Fig. 48) ..... **Eucharitidae** (p. 72)

18(16). Body nonmetallic in color. Pronotum about one-half as long as mesonotum (Figs. 41, 42, 43), or longer. Thorax usually with distinct thimblelike punctation (Fig. 42), or if finely sculptured, then antennae with 4–6 funicle segments 19

Body at least partly metallic in color. Pronotum distinctly less than one-half length of mesonotum (Figs. 57, 61, 68). Thorax finely sculptured and antennae with 7–9 funicle segments 20

19(18). Body usually with distinct thimblelike punctation (Fig. 42), but if finely sculptured, then antennae inserted above ventral margin of eyes (Fig. 38). Face without interantennal crest. Marginal vein of fore wing at most three times length of stigmal vein (Fig. 44). Propodeum often flattened medially or with medial longitudinal channel. Genae sometimes sharp-edged (Fig. 39) ..... **Eurytomidae** (p. 61)

Body finely sculptured and antennae inserted at or below ventral margin of eyes. Face with interantennal crest (Fig. 2). Marginal vein of fore wing four times or more length of stigmal vein (Fig. 65). Propodeum without medial longitudinal channel, sometimes evenly convex. Genae rounded ..... **Pteromalidae** (in part) (p. 75)

20(18). Gaster with transverse rows of pits at least on middle segments (Fig. 25). Females with ovipositor only slightly exserted from apex of gaster (Fig. 25). ..... **Ormyridae** (p. 42)

Gaster smooth, without transverse rows of pits. Females sometimes with ovipositor projecting greatly from apex of gaster 21

21(20). Gaster sessile, with petiole not visible and with base of gaster almost as broad as propodeum (Fig. 84). Body not metallic in color. Antenna (excluding anelli) with at most 8 segments. Winged forms with stigmal and postmarginal veins reduced, indistinct (Fig. 84). Insect minute, usually 1 mm long or less ..... **Aphelinidae** (in part) (p. 121)

Gaster constricted at junction with propodeum (Fig. 83), petiole present, though possibly wider than long. Body often at least partly metallic in color. Antenna (excluding anelli) with more than 8 segments. Winged forms with stigmal and postmarginal veins developed (Figs. 33, 66). Insect usually much longer than 1 mm 22

22(21). Males only. Mid tibial spur conspicuously longer than hind tibial spurs (Fig. 35) ..... **Eupelmidae** (in part) (p. 54)

Males and females. Mid tibial spur shorter or at most only slightly longer than inner hind tibial spur (Fig. 53) 23

23(22). Hind coxa large, elongate, two-thirds or more length of femur (Fig. 19), in cross section triangular, with dorsal edge angular. Female with ovipositor greatly exserted from apex of gaster (Fig. 19), possibly longer than body. Mesepimeron often with posterior margin sinuate (Fig. 19). Fore wing sometimes with knoblike stigma (Fig. 21) ..... **Torymidae** (in part) (p. 36)

Hind coxa smaller, in cross section more or less circular, with dorsal edge rounded. Female with ovipositor only slightly exserted from apex of abdomen. Mesepimeron with posterior edge straight or evenly curved. Fore wing without knoblike stigma 24

24(23). Propodeum usually pilose, with median third having several hairs that converge toward midline (Fig. 72). Fore tibial spur straight .... **Tetracampidae** (in part) (p. 104)

Propodeum with at least median third bare (Fig. 51). Fore tibial spur usually strongly curved (Fig. 53) ... **Pteromalidae** (in part) (p. 75)

Clé d'identification des familles de la super-famille Chalcidoidea

1. Pétiole de 2 articles (fig. 87). Ailes antérieures pédonculées et entièrement réticulées (fig. 89, 91). Torulus des antennes près l'un de l'autre et au même niveau que le bord dorsal des yeux .... **Mymarommatidæ** (p. 127)

Pétiole de 1 article, ou abdomen largement attaché. Ailes antérieures non pédonculées, ou ailes pédonculées mais non réticulées (fig. 95). Torulus des antennes séparés nettement l'un de l'autre; s'ils sont près l'un de l'autre, alors ils sont plus ventraux que le bord dorsal des yeux 2

2(1). Torulus beaucoup plus près du bord interne des yeux que l'un de l'autre sauf dans la sous-famille Eubroncinæ (fig. 94); juste au-dessus des torulus, front avec suture transversale prolongée aux deux extrémités par une suture supra-orbitale longeant le bord interne des yeux (fig. 94). Nervation nettement réduite; nervure marginale courte, nervure du stigma rudimentaire et habituellement terminée avant le milieu de l'aile (fig. 93, 95) ..... **Mymaridæ** (p. 130)

Torulus pas plus près du bord interne des yeux que l'un de l'autre; front dépourvu de suture transversale, mais parfois marqué d'une fourche. Nervation habituellement plus développée, nervures stigmale et postmarginale distinctes; nervure du stigma habituellement terminée au-delà du milieu de l'aile 3

3(2). Tarses de 3 articles; gastre largement attaché, taille de 0,5 à 1,0 mm; nervure postmarginale absente (fig. 86); funicule de l'antenne de 0 à 2 articles (fig. 86); les soies de l'aile antérieure placées en rangs longitudinaux chez beaucoup d'espèces .... **Trichogrammatidæ** (p. 125)

Tarses de 4 ou 5 articles; gastre étroitement attaché, ou largement attaché, alors taille de 1 à 5 mm; nervure postmarginale rudimentaire, légèrement aiguë ou allongée (fig. 10, 44, 66, 72, 80), funicule de l'antenne de 0 à 7 articles; les soies de l'aile antérieure rarement placées en rangs longitudinaux 4

4(3). Coxa postérieur énorme et aplati (fig. 73); tibia postérieur souvent orné d'un losange de soies (fig. 73) .... **Eulophidæ** (en partie) (p. 107)

Coxa postérieur typique ou énorme, mais non aplati (fig. 19, 25, 33); tibia postérieur sans losange de soies 5

5(4). Gastre largement attaché, avec le segment basal aussi large que le propodéum (fig. 32); propodéum triangulaire dans la zone médiane; scutellum en forme de ruban dans le sens transversal .... **Signiphoridæ** (p. 53)

Gastre au plus étroitement attaché, le segment basal au moins légèrement plus étroit que le propodéum (fig. 28) ou pétiolé; propodéum non triangulaire dans la zone médiane; scutellum rarement en forme de ruban dans le sens transversal 6

6(5). Tarse postérieur de 4 articles 7

Tarse postérieur de 5 articles 10

7(6). Nervure marginale de l'aile antérieure plus courte que large ou indistincte (fig. 26, 30). Mésoscutum uniformément convexe sans notaulices (fig. 28). Coxa médian inséré au milieu ou légèrement avant le milieu du mésépisterne (fig. 29) ..... **Encyrtidæ** (en partie) (p. 44)

Nervure marginale de l'aile antérieure nettement plus longue que large (fig. 44, 84). Mésoscutum présentant des notaulices incomplètes ou complètes. Coxa médian inséré à l'extrémité postérieure du mésépisterne ou près de celle-ci 8

8(7). Gastre largement attaché, la base presque aussi large que le propodéum. Nervures stigmale et postmarginale de l'aile antérieure réduites et indistinctes (fig. 84). Corps sans couleur métallique. Scutellum dépourvu de sillons sous-médians .. **Aphelinidæ** (en partie) (p. 121)

Gastre étroitement attaché (pétiolé) (fig. 47, 72, 83). Nervures stigmale et postmarginale de l'aile antérieure nettement développées. D'habitude, le corps partiellement de couleur métallique. Scutellum habituellement pourvu de sillons sous-médians (fig. 4, 78) 9

9(8). Antennes de 11 ou 12 articles et de 6 funicules. Propodéum garni au moins de plusieurs poils sur le tiers médian, inclinés vers le milieu (fig. 72) ..... **Tetracampidæ** (en partie) (p. 104)

Antennes d'au plus 10 articles distincts et de 2 à 4 funicules (fig. 73, 83). Tiers médian du propodéum glabre ..... **Eulophidæ** (p. 107)

10(6). Fémur postérieur au bord ventral dentelé (fig. 15) ou pourvu d'au moins une dent distincte (fig. 9); d'habitude, fémur postérieur considérablement enflé (fig. 9, 10, 12) 11

Fémur postérieur non dentelé, ni pourvu de dent; fémur postérieur non enflé 14

11(10). Gastre rayé jaune et noir, densément pointillé comme un dé à coudre. L'aile antérieure repliée longitudinalement comme celle des guêpes vespoïdes. Chez la femelle, ovipositeur recourbé sur le côté dorsal du gastre (fig. 9) ..... **Leucospidæ** (p. 27)

Gastre non rayé jaune et noir et finement sculpté mais pointillé comme un dé à coudre chez les Ormyridæ. L'aile antérieure non repliée longitudinalement comme celle des guêpes vespoïdes. Chez la femelle, ovipositeur dépassant légèrement le gastre ou au moins non recourbé au-dessus de ce dernier 12

12(11). Prépectus invisible ou représenté par une petite plaque discrète près de la tegula (fig. 10). Corps sans couleur métallique, habituellement noir ou marqué de taches blanches, jaunes ou rouges. Thorax sculpté grossièrement ..... **Chalcididæ** (p. 29)

Prépectus large et évident (fig. 19). Corps habituellement de couleur métallique. Thorax en général finement sculpté 13

13(12). Les bords internes des yeux divergent nettement du côté ventral. Antennes insérées sous le bord ventral des yeux (fig. 52, 58) .... **Pteromalidæ** (en partie) (p. 75)

Les bords internes des yeux divergent au plus légèrement du côté ventral. Antennes insérées au moins légèrement au-dessus du bord ventral des yeux (fig. 19) ..... **Torymidæ** (en partie) (p. 36)

14(10). Mésopleure nettement élargi et enflé (fig. 29, 35). Éperon du tibia médian large et épaissi (fig. 35); chez la femelle, articles de la base du tarse médian épaissis, et au moins le premier article pourvu du côté ventral de deux rangées d'épines courtes et épaisses (fig. 35) 15

Mésopleure ni élargi ni enflé (fig. 39). Éperon du tibia médian habituellement ni épaissi ni garni d'épines ventrales (fig. 53); chez la femelle, articles de la base du tarse médian non épaissis, et le premier article sans rangées d'épines du côté ventral 16

15(14). Coxa médian inséré environ au milieu du mésopleure. Gastre droit (chez les spécimens séchés), et couramment court et épais. D'habitude, mésonotum uniformément convexe (fig. 29), quoique rarement pourvu de notaulices linéaires; nervure marginale en général courte ou absente (fig. 26, 30) ..... **Encyrtidae** (en partie) (p. 44)

Coxa médian inséré à l'extrémité postérieure du mésopleure ou derrière lui (fig. 33, 35). Gastre habituellement allongé, en forme caractéristique de U chez les spécimens séchés. Mésonotum largement déprimé au moins postérieurement (fig. 36); nervure marginale plus longue (nettement plus longue que la nervure du stigma) .... **Eupelmidæ** (en partie) (p. 54)

16(14). Prépectus fusionné avec la partie latérale du pronotum et situé dans le même plan. Thorax habituellement haut et court en vue latérale (fig. 48, 50). D'habitude, les tergites 1 et 2 du gastre cachant plus ou moins les tergites postérieurs 17

Prépectus non fusionné avec la partie latérale du pronotum et situé dans un autre plan. Thorax habituellement ni élevé ni court en vue latérale. Plus de deux tergites du gastre en général visibles 18

17(16). Pronotum nettement visible en vue dorsale, mais étroit (fig. 49). Mandibules d'une autre forme qu'en faucille. Pétiole habituellement court, transversal et au moins deux fois plus large que long. Gastre de forme triangulaire caractéristique (fig. 49) .... **Pteromalidæ** (en partie) (p. 75)

Pronotum invisible en vue dorsale, caché par le mésoscutum fortement convexe (fig. 47). Mandibules en forme de faucille (fig. 46). Pétiole plus long que large, et souvent de façon notable. Gastre en forme typique de gouvernail (fig. 48) ..... **Eucharitidæ** (p. 72)

18(16). Corps sans couleur métallique. Pronotum environ la moitié aussi long que le mésonotum (fig. 41, 42, 43), ou plus long. Le thorax en général nettement pointillé comme un dé à coudre (fig. 42), ou s'il est finement sculpté, les antennes pourvues de 4 à 6 funicules 19

Corps au moins partiellement de couleur métallique. Pronotum nettement moins long que la moitié de la longueur du mésonotum (fig. 57, 61, 68). Thorax finement sculpté et antennes pourvues de 7 à 9 funicules 20

19(18). Le corps en général nettement pointillé comme un dé à coudre (fig. 42), mais si finement sculpté, les antennes insérées au-dessus du bord ventral des yeux (fig. 38). Face sans crête entre les antennes. Nervure marginale de l'aile antérieure au plus trois fois aussi longue que la nervure du stigma (fig. 44). Propodéum souvent aplati ou pourvu d'un canal longitudinal dans la zone médiane. Joue quelquefois pourvue d'une carène (fig. 39) ..... **Eurytomidæ** (p. 61)

Corps finement sculpté et antennes insérées au niveau ou sous le bord ventral des yeux. Face pourvue d'une crête entre les antennes (fig. 2).

Nervure marginale de l'aile antérieure au moins quatre fois aussi longue que la nervure du stigma (fig. 65). Propodéum sans canal longitudinal dans la zone médiane et quelquefois uniformément convexe. Joues arrondies ..... **Pteromalidæ** (en partie) (p. 75)

20(18). Gastre au moins pourvu de rangées transversales de petites fosses sur les segments médians (fig. 25). Chez la femelle, ovipositeur ne dépassant que légèrement l'apex du gastre (fig. 25) ..... **Ormyridæ** (p. 42)

Gastre lisse, sans rangées transversales de petites fosses. Quelquefois chez la femelle, l'ovipositeur dépasse nettement l'apex du gastre ... 21

21(20). Gastre largement attaché, pétiole invisible et base du gastre presque aussi large que le propodéum (fig. 84). Le corps sans couleur métallique. Antennes (sans compter les annelets) d'au plus 8 articles. Nervures stigmale et postmarginale réduites et indistinctes (fig. 84). Insecte minuscule, habituellement d'au plus 1 mm de longueur .... **Aphelinidæ** (en partie) (p. 121)

Gastre étranglé à la jonction avec le propodéum (fig. 83), pétiole présent, quoique parfois plus large que long. Souvent, le corps au moins partiellement de couleur métallique. Antennes (sans compter les annelets) de plus de 8 articles. Nervures stigmale et postmarginale développées (fig. 33, 66). Insecte habituellement beaucoup plus long que 1 mm 22

22(21). Mâles seulement. Éperon du tibia médian nettement plus long que ceux du tibia postérieur (fig. 35) ..... **Eupelmidæ** (en partie) (p. 54)

Mâles et femelles. Éperon du tibia médian plus court ou au plus seulement légèrement plus long que l'éperon intérieur du tibia postérieur (fig. 53) 23

23(22). Coxa postérieur large, allongé, au moins aussi long que les deux tiers du fémur (fig. 19), triangulaire en section transversale et à bord dorsal anguleux. Chez la femelle, ovipositeur dépassant nettement l'apex du gastre (fig. 19) et parfois plus long que le corps. Bord postérieur du mésépimère souvent ondulé (fig. 19). Stigma de l'aile antérieure quelquefois en forme de bouton (fig. 21) .... **Torymidæ** (en partie) (p. 36)

Coxa postérieur plus petit, plus ou moins circulaire en section transversale, à bord dorsal arrondi. Chez la femelle, ovipositeur ne dépassant que légèrement l'apex de l'abdomen. Bord postérieur du mésépimère droit ou uniformément arrondi. Le stigma de l'aile antérieure n'est pas en forme de bouton 24

24(23). Propodéum habituellement pilifère. Le tiers médian est garni de plusieurs poils qui convergent vers le centre (fig. 72). Éperon du tibia antérieur droit ..... **Tetracampidæ** (en partie) (p. 104)

Propodéum dont au moins le tiers médian est glabre (fig. 51). Éperon du tibia antérieur habituellement courbé fortement (fig. 53) ..... **Pteromalidæ** (en partie) (p. 75)

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Family 1 Leucospidae

Fig. 9

The family Leucospidae is closely related to the Chalcididae and contains some of the largest chalcidoids up to 20 mm long. The body is robust and wasplike, and may have a red or yellow pattern on black. Members of this family are distinguished from other families by the following characters: Fore wings folded in half longitudinally when at rest (not always so in dried specimens), much as in the Vespidae; wing pubescent, with marginal vein several times longer than stigmal vein. Tergite 2 of males shorter than tergite 1; tegula narrowly elongate, reaching pronotum. Ovipositor sheath recurved dorsally over gaster, often reaching scutellum, concealing ovipositor when at rest (Fig 9). Hind coxae enlarged; hind femora swollen and ventrally dentate; hind tibiae curved as in Chalcedectinae, Chalcididae, and Podagrionini. Body, including gaster, highly sclerotized and coarsely punctate.

Members of this family are known to be ectoparasites of solitary bees and, less frequently, of solitary wasps (Aculeata, Hymenoptera). Graenicher (1906), referring to *Leucospis affinis* (Say), gave an account of the life history and habits (Clausen 1940). Occasionally, parasitic bees, e.g., *Coelioxys* spp. and *Stelis* spp., have been recorded as hosts; these were probably attacked by the leucospids when occupying the same cell of a solitary bee after the death of the original owner (Bouček 1975). The leucospids are generally bisexual, but some species are able to reproduce

parthenogenetically (Bouček 1975). Only one species, *Leucospis affinis* (Say), occurs in Canada, and it is parasitic on various megachilid bees. Bouček (1975) revised the world species of Leucospidae and included keys to 4 genera (1 Nearctic), and 130 species (6 Nearctic).

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Fig. 9. Family 1 Leucospidae: female *Leucospis affinis* (Say): lateral view of habitus.

Family 2 Chalcididae

Figs. 10, 12, 13

Adults of the family Chalcididae are usually black, sometimes reddish or with pale markings, robust, and large. Members of this family can be identified by the following characters: Body highly sclerotized, not metallic in color, with head and thorax coarsely punctate and thorax having distinct notauli. Hind coxae enlarged; hind femora swollen and toothed ventrally; hind tibia curved (Figs. 10, 12, 13) as in Leucospidae, Chalcedectinae (Pteromalidae), and Podagrionini, Monodontomerinae (Torymidae). Gaster not punctate. Prepectus small, inconspicuous (Fig. 5). Ovipositor barely protruding from body (Fig. 5).

The included species are largely parasitic on pupae of Lepidoptera or on maggots and puparia of Diptera, though they have also been reared from Hymenoptera, Orthoptera, Coleoptera, and Neuroptera.

Masi (1916, 1929*a*, 1929*b*) published a series of papers on this family. Habu (1960) has given an excellent synopsis of the family in Japan, and Bouček (1952) made a comprehensive study of the European Chalcididae with synonymies and keys to genera and species.

Key to subfamilies of Chalcididae

1. Gaster with elongate petiole (Fig. 5) ..... **Chalcidinae** (p. 30)
   Gaster sessile or with petiole short, as wide or wider than long 2
2(1). Antenna inserted at or above level of ventral margin of eyes. Hind tibia with 1 spur; apex of tibia obliquely truncate (Fig. 12) ..... **Brachymeriinae** (p. 31)
   Antenna inserted below level of ventral margin of eyes. Hind tibia with 2 spurs or without spur; apex of tibia abruptly truncate (Fig. 13), or apex of tibia prolonged apically and pointed 3
3(2). Hind tibia with 2 spurs. Head without horns .. **Haltichellinae** (p. 32)
   Hind tibia without spur. Head produced into 2 horns ..... **Dirhininae** (p. 32)

Clé d'identification des sous-familles des Chalcididæ

1. Gastre à pétiole allongé (fig. 5) ..... **Chalcidinæ** (p. 30)
   Gastre largement attaché ou à pétiole court, aussi large ou plus large que long 2
2(1). Antennes insérées au niveau ou au-dessus du niveau du bord ventral des yeux. Tibia postérieur garni de 1 éperon; apex du tibia tronqué obliquement (fig. 12) ..... **Brachymeriinæ** (p. 31)
   Antennes insérées sous le niveau du bord ventral des yeux. Tibia postérieur garni de 2 éperons ou complètement dépourvu d'éperon;

apex du tibia tronqué abruptement (fig. 13), ou prolongé et pointu 3

3(2). Tibia postérieur garni de 2 éperons. Tête sans corne ..... **Haltichellinæ** (p. 32)

Tibia postérieur sans éperon. Tête garnie de deux cornes ..... **Dirhininæ** (p. 32)

Subfamily 1 Chalcidinae

Fig. 10

This subfamily is distinguished from all other Chalcididae by the following characters: Antennae inserted at middle of frons. Hind tibia arcuate, with one weak spur. Gaster petiolate (Fig.10).

The Canadian Chalcidinae are represented by three genera: *Chalcis* Fabricius, *Ceratosmicra* Ashmead, and *Spilochalcis* Thompson.

Fig. 10. Family 2 Chalcididae, subfamily 1 Chalcidinae: female *Chalcis* sp.: lateral view of habitus.

Keys to the 5 genera and 49 species of this subfamily in North America are found in Burks (1940). Burks (1979) listed 49 genera and 54 species. He included *Xanthomelanus* Ashmead, a Neotropical genus.

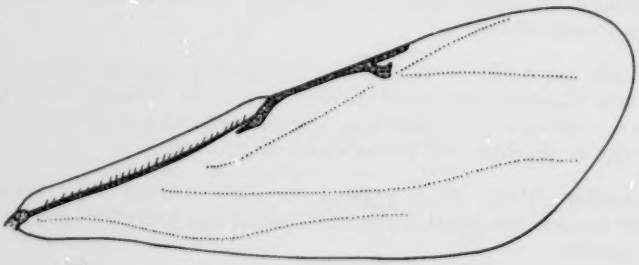
Members of the genus *Spilochalcis* parasitize pupae of Lepidoptera, Coleoptera, Hymenoptera, and, rarely, cyclorrhaphous Diptera. Species of *Chalcis* parasitize larvae of Stratiomyiidae (Diptera), found in marshy habitats, and *Ceratosmicra* are hyperparasites on larvae of Braconidae and Ichneumonidae (Hymenoptera) through Lepidoptera.

The genus *Spilochalcis* is widely distributed throughout the Nearctic region.

Subfamily 2 Brachymeriinae

Figs. 11, 12

This subfamily is recognized by the following characters: Head with frons somewhat flattened. Antennae inserted at or above level of ventral margin of eyes. Marginal vein touching wing margin (Fig. 11). Hind tibia arcuate, ventroapically forming sharp projection (Fig. 12); mid tibia with single apical spur.



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Figs. 11, 12. Family Chalcididae, subfamily 2 Brachymeriinae: *Brachymeria* sp.: 11, fore wing; 12, hind leg.

The subfamily Brachymeriinae in Canada is represented by three genera: *Phasgonophora* Westwood, *Trigonura* Sichel, and *Brachymeria* Westwood. The last two of these were revised for North America by Burks (respectively 1959, 1960).

The members of this subfamily are common and widely distributed throughout the world. The species of *Brachymeria* are primary or secondary parasites of Lepidoptera and Diptera; those of the other two Canadian genera, *Trigonura* and *Phasgonophora*, as far as is known, are primary parasites of buprestid and scolytid beetles (Coleoptera) developing in wood or under bark (Burks 1959).

Subfamily 3 Haltichellinae

Figs. 13–15

This subfamily is recognized by the following characters: Head usually wider than thorax, without horns on frons dorsally. Antennae inserted below ventral margin of eyes (Fig. 13). Preorbital carina along eye margins distinct, except in *Hockeria* Walker. Frons flat, with scrobe forming deep depression with indistinct margins. Marginal vein touching wing margin (Fig. 14). Apex of outer ventral edge of hind femur densely pectinate with small teeth (Fig. 15); apex of tibia truncate with 2 apical spurs. Petiole short.

This subfamily is represented by three genera in North America. The only Canadian record is *Haltichella xanticles* (Walker), from Québec; however, with further collecting, additional species of *Haltichella* Spinola and also of *Hockeria* will probably be discovered.

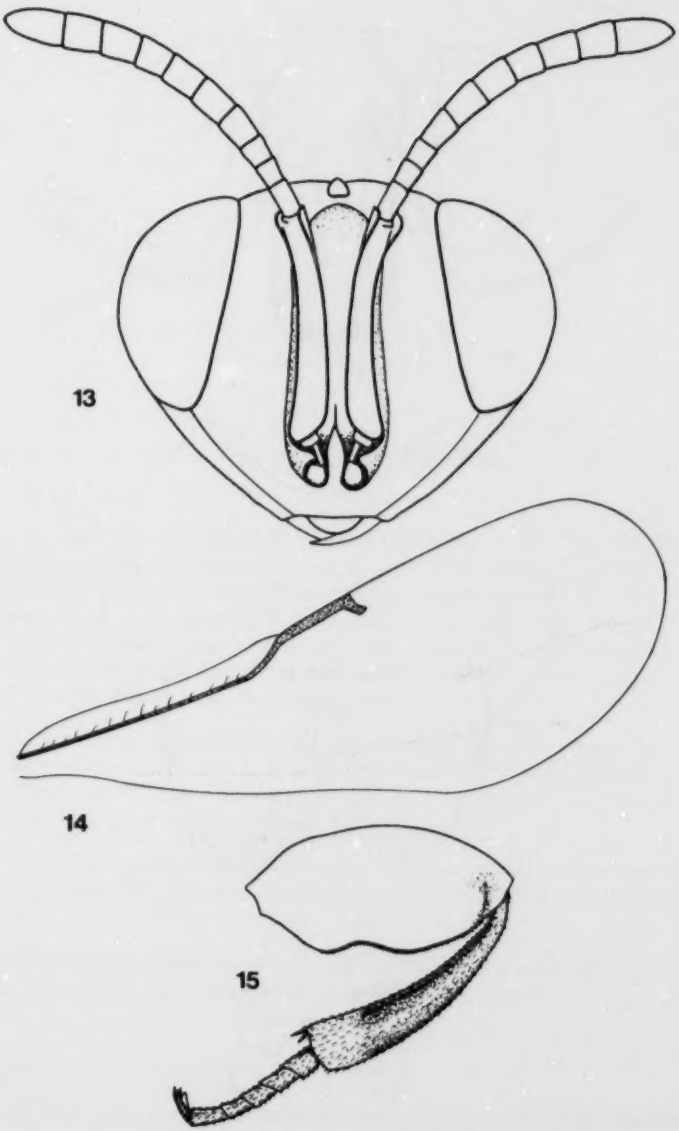
Steffan (1951, 1953) revised the Haltichellinae of France. Habu (1960) revised the Haltichellinae of Japan and provided keys to genera and species.

The members of this subfamily parasitize Coleoptera, Lepidoptera, Neuroptera, and Hymenoptera.

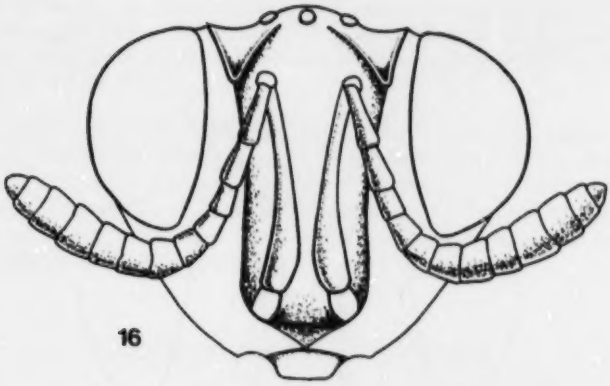
Subfamily 4 Dirhininae

Figs. 16–18

This subfamily is recognized by the following characters: Body elongate, subcylindrical, or dorsally somewhat depressed. Frons prolonged into two hornlike projections (Fig. 17), with scrobes deeply excavated. Mandibles elongate, with 2 or 3 short teeth. Genae without malar groove.



Figs. 13–15. Family Chalcididae, subfamily 3 Haltichellinae: *Haltichella* sp.: 13, frontal view of head; 14, fore wing; 15, hind leg.



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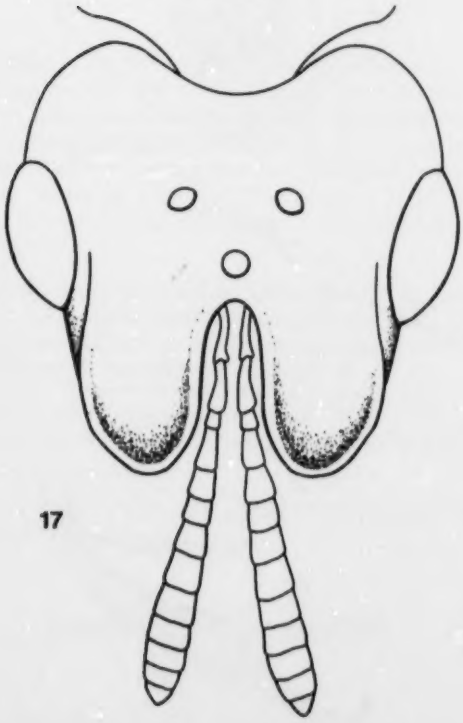

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Figs. 16, 17. Family Chalcididae, subfamily 4 Dirhininae: *Dirhinus* sp.: 16, frontal view of head; 17, dorsal view of head.

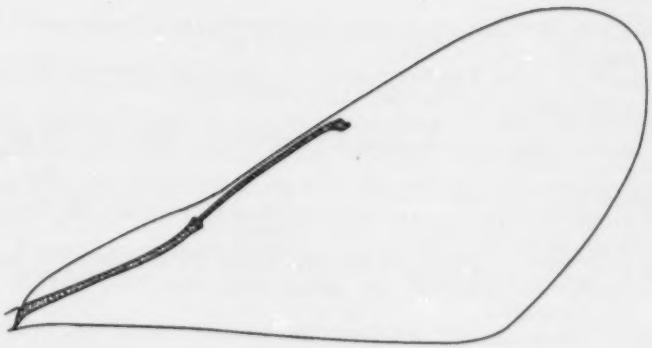

Fig. 18. Family Chalcididae, subfamily 4 Dirhininae: *Dirhinus* sp.: fore wing.

Antennae inserted below level of posterior margin of eyes (Fig. 16). Fore wing with rudimentary postmarginal and stigmal veins (Fig. 18). Propodeum horizontal, flat, with characteristic cuplike cavity, or cell, with regular or irregular formation of carinae. Hind tibia prolonged into sharp spinelike projection, with strong spur. Gastral petiole often transverse, often with longitudinal carinae; gaster without coarse punctures except strongly striate area behind petiole.

The North American members of Dirhininae are represented by the single genus *Dirhinus* Dalman. It is not yet recorded from Canada but is known from the USA as far north as Illinois. Additional collecting may show that *Dirhinus* does extend into Canada.

Burks (1947) revised the North American species of *Dirhinus*. Bouček and Narendran (1981) revised the Indian species of *Dirhinus* with key and synonymy.

The members of this subfamily are parasitic on pupae of Tephritidae, Calliphoridae, Sarcophagidae, and Muscidae (Diptera).

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Family 3 Torymidae

Figs. 19–24

The family Torymidae consists of 24 Nearctic genera and 211 Nearctic species of moderately sized chalcids up to 5 mm long. They are recognized by the following characters: Body metallic green, blue, golden, or purplish except for the Megastigminae, which are primarily yellowish or brownish, though often with black markings. Hind coxae enlarged and elongate as in Chalcididae, but trihedral, and triangular in cross section rather than round. Sculpture of body more delicate than that of Chalcididae, and ovipositor of female generally long (Fig. 19). Hind tibiae straight, and hind femora never enlarged in Canadian representatives.

Four subfamilies, Toryminae, Megastigminae, Monodontomerinae, and Sycophaginae (Fig. 20), are currently recognized from North America. The first three are represented in Canada.

Most torymids are primary parasites of gall-forming insects; others are secondary parasites on lepidopterous cocoons or dipterous puparia, and a few are phytophagous.

Key to subfamilies of Torymidae

1. Mesepimeron notched on upper margin (Fig. 19) ..... **Toryminae** (p. 37)
Mesepimeron straight on upper margin (Fig. 22) 2
2(1). Stigma of fore wing knoblike (Fig. 21). Color not metallic, generally yellowish to brownish, often with black margins. Hind femur of leg not toothed ventroapically ..... **Megastigminae** (p. 39)
Stigma of fore wing not enlarged (Fig. 23). Color often metallic. Hind femur of leg sometimes with one or more denticles or teeth ventroapically (Fig. 24) ..... **Monodontomerinae** (p. 40)

Clé d'identification des sous-familles des Torymidæ

1. Bord dorsal du mésépimère entaillé (fig. 19) ..... **Toryminæ** (p. 37)
Bord dorsal du mésépimère droit (fig. 22) 2
2(1). Stigma de l'aile antérieure en forme de bouton (fig. 21). Corps sans couleur métallique, variant habituellement de jaunâtre à brunâtre, et souvent bordé de noir. Fémur postérieur lisse du côté ventro-apical ..... **Megastigminæ** (p. 39)
Stigma de l'aile antérieure non élargi (fig. 23). Corps souvent de couleur métallique. Fémur postérieur quelquefois garni d'au moins une dent du côté ventro-apical (fig. 24) ..... **Monodontomerinæ** (p. 40)

Subfamily 1 Toryminae

Fig. 19

The Canadian members of Toryminae consist of three genera: *Allotorymus* Huber, *Diomorus* Walker, and *Torymus* Dalman. Grissell (1976) provided a key to the genera of this subfamily and revised the western Nearctic species of *Torymus*.

This subfamily is recognized by the following characters: Mesepimeron notched along dorsal posterior margin (Fig. 19). Stigmal vein short, with sessile to petiolate stigma.

Torymids are ectoparasites on gall-forming insects of the families Cecidomyiidae and Cynipidae. Some species are parasites on gall-forming Psyllidae, Eurytomidae, and Tephritidae (Grissell 1976). A few species have been reared from Coleoptera and Lepidoptera larvae and a single species is known from Cicadidae eggs.

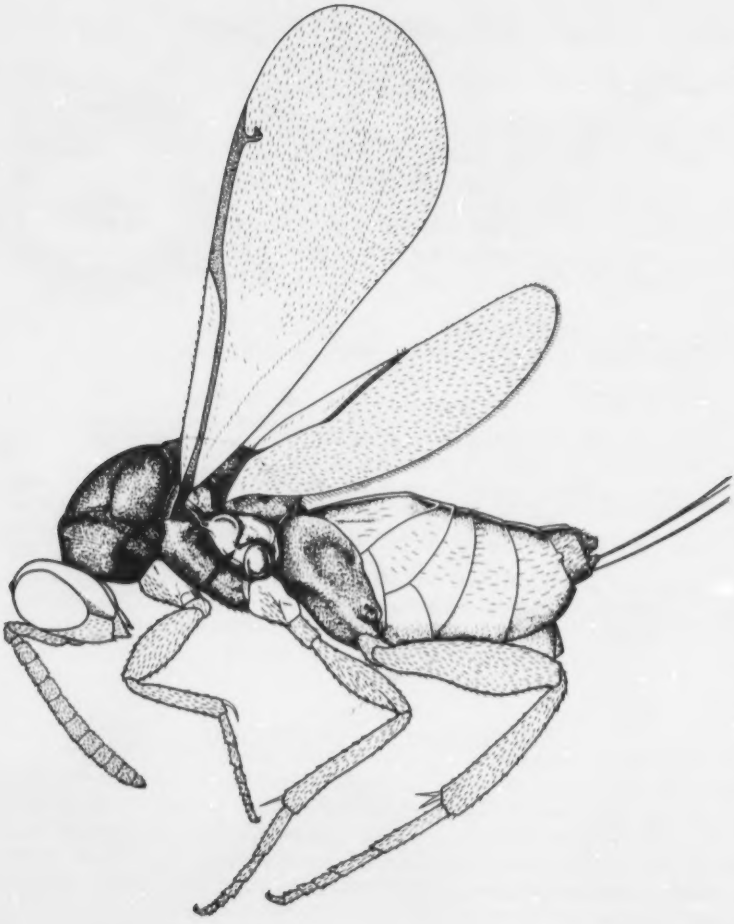
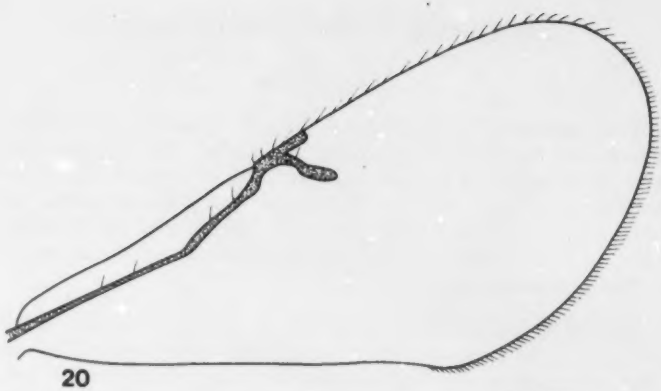


Fig. 19. Family 3 Torymidae, subfamily 1 Toryminae: female *Torymus* sp.: lateral view of habitus.



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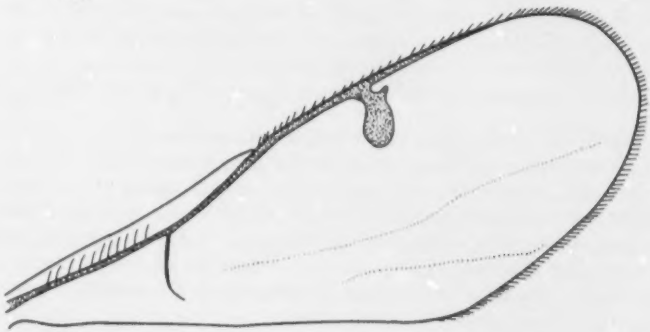

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Figs. 20, 21. Family 3 Torymidae: 20, subfamily Sycophaginae: female *Idarnes* sp.: fore wing; 21, subfamily 2 Megastigminae: female *Megastigmus* sp.: fore wing.

Subfamily 2 Megastigminae

Fig. 21

The subfamily Megastigminae in Canada is represented by the single genus *Megastigmus* Dalman. This genus is easily separated from other torymids by the following characters: Stigma large, oblong or dilated knob-shaped (Fig. 21). Coloring nonmetallic. Pronotum elongate (this appearing rectangular to quadrate). Striae of thorax usually transverse.

Milliron (1949) revised the Nearctic species and provided a key to species.

Subfamily 3 Monodontomerinae

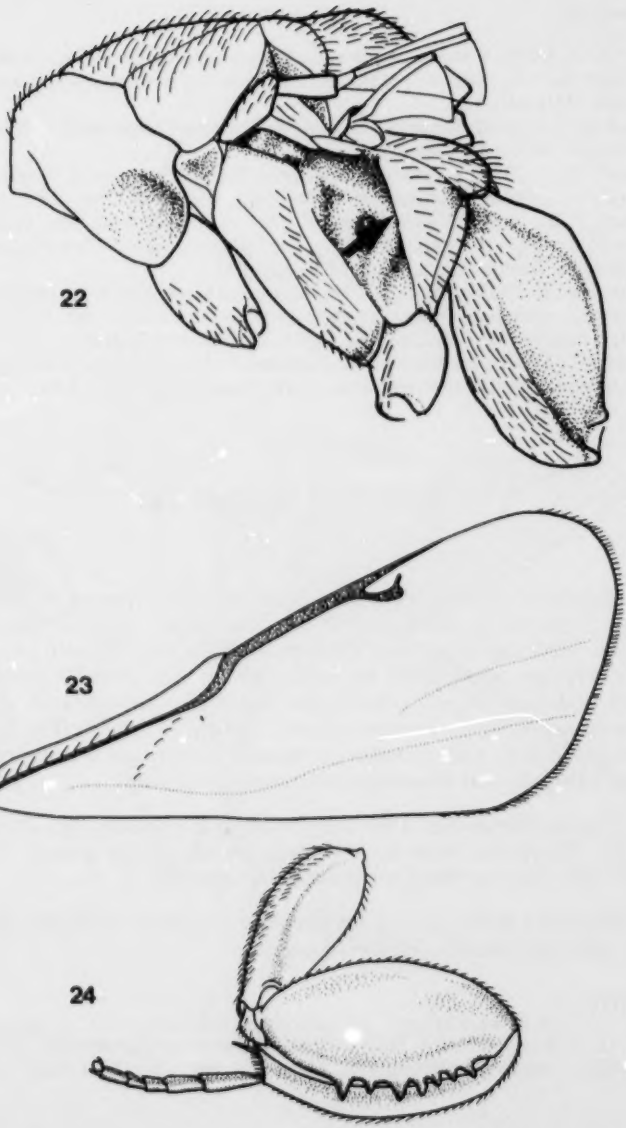
Figs. 22–24

This subfamily is recognized by the following characters: Mesepimeron not notched on posterior edge (Fig. 22). Stigmal vein short, sessile, with stigma as long as wide or slightly longer (Fig. 23); notauli well-defined. The tribes Podagrionini and Monodontomerini have generally been accorded subfamily rank, but Bouček (1978), after studying the African fauna, reduced the Podagrioninae to tribal status under the Monodontomerinae.

Grissell and Goodpasture (1981) review the Nearctic Podagrionini with keys to the tribes and to females of the known species. The members of this tribe are recognized by the following characters: Hind femur 1.5–2.5 times longer than wide; hind tibia arcuate (Fig. 24), with ventral apex pointed. *Podagrion* Spinola (tribe Podagrionini) is the only representative of this tribe in North America and as yet is not known from Canada. Species of *Podagrion* are parasitic on eggs of Mantidae (Dictyoptera).

Members of the Nearctic Monodontomerini are recognized as follows: Hind femur three, or more, times longer than wide, ventrally with a single tooth, often serrate; hind tibia, with 2 apical spurs posteriorly, straight, with apex truncate. Members of the North American Monodontomerini are currently divided into 13 genera; of these, eight genera are known from Canada. They are *Liodontomerus* Gahan, *Monodontomerus* Westwood, *Glyphomerus* Förster, *Eridontomerus* Crawford, *Pseudotorymus* Ashmead, *Cryptopristus* Förster, *Ditropinotus* Crawford, and *Microdontomerus* Crawford. These genera can be identified using the world key provided by Szelényi (1957). Species of this tribe are diversified in their parasitism, having been reared from alfalfa seed chalcids (*Bruchophagus*), alfalfa leafcutting bee (*Megachile*), and wheat jointworms (*Harmolita*) (Hymenoptera); from boll weevil (*Anthonomus*) (Coleoptera); and from larvae and pupae of Diptera and Lepidoptera.

The tribe Erimerini (= Erimerinae) is represented in North America by the genera *Erimerus* Crawford and *Pseuderimerus* Gahan. The members of this tribe are similar to those of Monodontomerini, but they can be separated from the latter by the presence of a single apical spur (Crawford 1914; Grissell and Goodpasture 1981). As yet there are no records from Canada, but because the three known species of *Pseuderimerus* are parasites of the Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), they may yet be discovered in Western Canada.



Figs. 22–24. Family 3 Torymidae, subfamily 3 Monodontomerinae: 22, *Monodontomerus* sp.: lateral view of thorax; 23, fore wing; 24, (Podagrionini), *Podagrion* sp.: hind leg.

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Family 4 Ormyridae

Fig. 25

Members of the family Ormyridae resemble those of the Torymidae in the large three-sided hind coxae, the sessile stigmal vein, and the metallic coloring. They are distinguished by the following characters: Body strongly sclerotized, in particular on the coarsely pitted gaster; gaster of female highly convex and bilaterally compressed, with punctures usually lying in rows on anterior margin of tergites (Fig. 25); gaster of male smaller, with punctures coarsely pitted; last tergite, the epipygium, elongate and concealing the short ovipositor.

Ormyrus Westwood is the only ormyrid in Canada, with three known species. There has been no revisionary study in this group. Peck et al. (1964) give keys to the Czechoslovakian species.

Members of this group are parasitic in galls of cynipids (Hymenoptera) and pteromalids (Hymenoptera).

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Fig. 25. Family 4 Ormyridae: female *Ormyrus* sp.: lateral view of habitus.

Family 5 Encyrtidae

Figs. 26–31

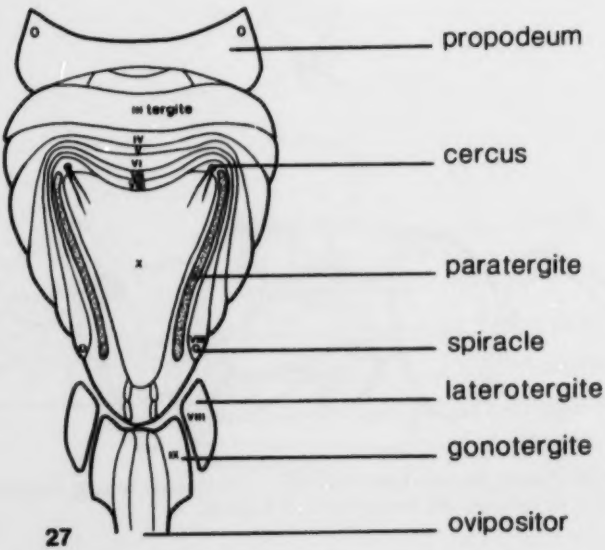
The family Encyrtidae is among the largest in the Hymenoptera with 500 genera and 2500 recognized species (Gordh and Trypitzin 1981). It contains relatively small forms, usually 1–2 mm long, though they may range up to 4 mm. Some of the genera and species resemble the Pteromalidae, Eupelmidae, Tanaostigmatinae, and Aphelinidae. The family is recognized by the following characters: Body generally compact (Figs. 28, 29), though somewhat flattened to strongly flattened forms and antlike forms occur. Mesopleuron more or less shining, with fine sculpture, enlarged and inflated, without impressed lines or grooves; mesepisternum and mesepimeron not differentiated. Middle legs usually with greatly enlarged and thickened mid tibial spur, and with enlarged basitarsus as in eupelmids (Fig. 31). Mesonotum almost always uniformly convex, with notauli either shallow or entirely absent. Prepectus divided into 2 triangular sclerites. Mid coxae usually widely separated from hind pair and inserted at or slightly in front of midline of mesopleuron (Fig. 29). Members of this family may sometimes be apterous or brachypterous, but in fully winged forms the marginal vein is much shorter than the submarginal (Figs. 26, 30).

The wing venation and position of the mid coxae are useful in separating the Encyrtidae from the Eupelmidae. The enlarged, inflated mesopleuron and enlarged mid tibial spur distinguish at least the females of Encyrtidae from those of other families of Chalcidoidea (other than Eupelmidae).

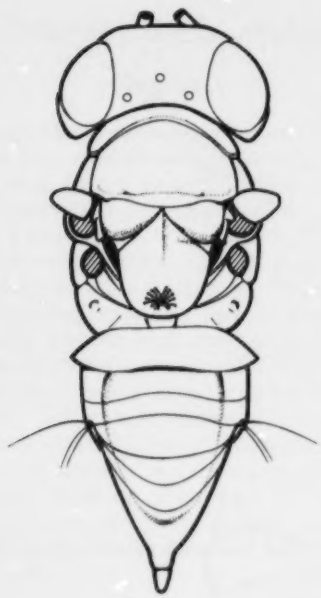
Members of this family primarily parasitize Coccoidea (Homoptera), though some are parasitic on the eggs or larvae of other insects and also ticks. It is a large family, and many species are potentially useful for biological control of insect pests.

Major encyrtid revisions were provided by Mercet (1921), Erdös and Novicky (1955), Compere and Annecke (1969), Tachikawa (1963), De Santis (1964), Kerrich (1967), Trypitzin and Gordh (1978*a*, 1978*b* (Nearctic key)), Noyes (1980), and Gordh and Trypitzin (1981).

In North America, the following genera of Encyrtidae were revised: *Anagyrus* (Timberlake 1924; Compere 1947); *Cerchysius* (Girault 1918); *Bothriothorax* (Howard 1895); *Homalotylus* (Timberlake 1919); *Microterys* (Compere 1926); *Isodromus* (Timberlake 1919); *Pseudaphycus* (Gahan 1946); *Acerophagus* (Timberlake 1916, 1918); *Aenasioides* (Timberlake 1916); *Aphycus* (Timberlake 1916); *Cheiloneurus* (Gahan 1914); *Diversinervus* (Compere 1931, 1938); *Coelopencyrtus* (Burks 1958); *Chrysoplatycerus* (Timberlake 1922); *Zarhopalus* (Timberlake 1924); *Eusemion* (Compere 1938); *Comperiella* (Compere 1926).



Figs. 26, 27. Family 5 Encyrtidae, subfamily 1 Tetracneminae: 26, female *Leptomastidea abnormis* (Girault): fore wing; 27, female *Anagyrus* sp.: dorsal view of gaster (after Compere 1947).



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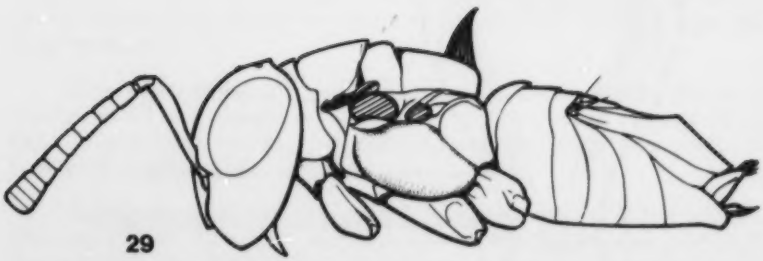

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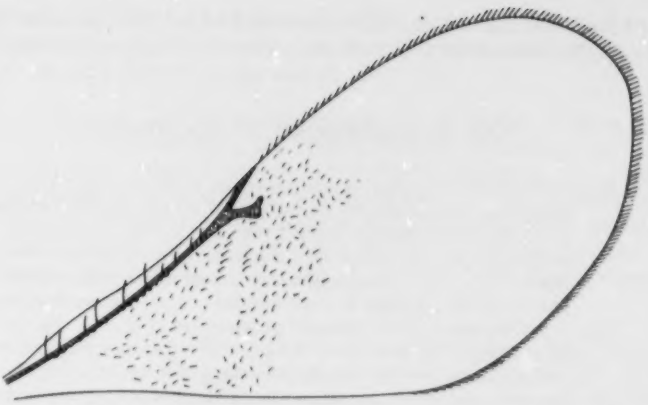
Figs. 28, 29. Family Encyrtidae, subfamily 2 Encyrtinae: female *Encyrtus* sp.: 28, dorsal view of habitus; 29, lateral view of habitus.



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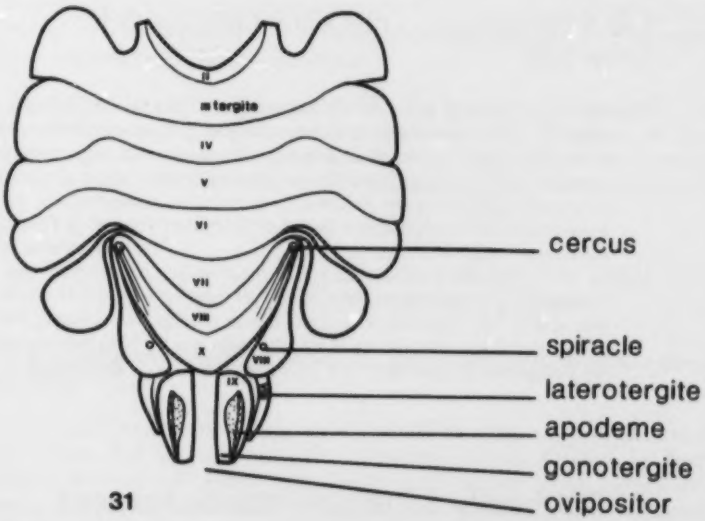

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Figs. 30, 31. Family Encyrtidae, subfamily 2 Encyrtinae: 30, female *Ooencyrtus ennomophagus* Yoshimoto: fore wing; 31, female *Metaphycus lounsburgi* (Howard): dorsal view of gaster (after Compere 1947).

The following key to subfamilies works for most Canadian Encyrtidae but the characters and subfamily classification are artificial.

Key to subfamilies of Encyrtidae

1. Gaster of female with paratergites (may be difficult to see) (Fig. 27). Fore wing with bare glabrous oblique band having undifferentiated margins (Fig. 26). Gastral sternite V (the last) in female triangular, usually attaining apex of gaster or extending beyond it and covering (not always, i.e., some *Anagyrus*) outer plates of ovipositor both laterally and ventrally (except in *Grandoriella*) .... **Tetracneminae** (p. 48)

Gaster of female usually without paratergites (Fig. 31). Fore wing with bare oblique band usually having differentiated margins (Fig. 30). Gastral sternite V in female not triangular, reaching apex of gaster and not covering outer plates of ovipositor both laterally and ventrally ..... **Encyrtinae** (p. 49)

Clé d'identification des sous-familles des Encyrtidæ

1. Gastre de la femelle pourvu de paratergites (parfois difficiles à voir (fig. 27). Aile antérieure à bande oblique glabre, sans bordure distincte (fig. 26). Le sternite V du gastre (le dernier) triangulaire chez la femelle, atteignant généralement ou dépassant l'apex du gastre et couvrant (pas toujours, comme chez certains *Anagyrus*) les plaques extérieures de l'ovipositeur des côtés latéral et ventral (à l'exception de *Grandoriella*) ..... **Tetracneminæ** (p. 48)

Gastre de la femelle habituellement dépourvu de paratergites (fig. 31). Aile antérieure à bande oblique nue et généralement à bordure distincte (fig. 30). Sternite V du gastre non triangulaire chez la femelle, atteignant l'apex du gastre et ne couvrant pas les plaques extérieures de l'ovipositeur des côtés latéral et ventral .... **Encyrtinæ** (p. 49)

Subfamily 1 Tetracneminae Howard

The characters of the subfamily are given in the key to subfamilies of Encyrtidae.

A classification of the family Encyrtidae by Trypitzin (1971, 1973*a*, 1973*b*) divided the Encyrtidae into two subfamilies, Tetracneminae and Encyrtinae. The Tetracneminae, recognized by the characters given in the key, was divided into 12 tribes and 11 subtribes (Trypitzin and Gordh 1978*a*, 1978*b*); Gordh (1979) included 6 tribes and 25 genera under Tetracneminae. In Canada, four tribes and seven genera are known.

Trypitzin (1977) based his new classification on comparative anatomy and on biological and ecological data. Tachikawa (1981) listed the hosts of encyrtid genera of the world.

The subfamily Tetracneminae Howard is divided into three tribes. In the first tribe (Anagyrini), the body is strongly flattened, the mouth parts are directed either downward or forward (hypognathous or prognathous), the antennae and legs are elongate, and the basal segment of the female antenna is somewhat cylindrical. This tribe comprises the following genera: *Anagyrus* Howard, *Anathrix* Burks, *Leptomastix* Förster, and *Leptomastidea* Mercet. They are largely parasites of Pseudococcidae (Homoptera).

In the second tribe (Chrysoplatycerini), the body is compact and not flattened and the antenna is almost always strongly flattened. This is represented by one species, *Chrysoplatycerus splendens* (Howard), a parasite of pseudococcoids (Homoptera).

In the third tribe (Ericydnini), the body is somewhat elongate, and the expansion of the parastigma is not triangular. A single species, *Clausenia purpurea* Ishii, a parasite of *Pseudococcus comstocki* (Kuwana) (Homoptera), is known from North America.

In the fourth tribe (Tetracnemini), the body is not especially compact, and the antennae of males have long funicle branches. A single species, *Paraleurocerus bicoloripes* Girault, a parasite of *Cameraria caryaefoliella* (Clemson) and *Lithocolletis* sp. (Lepidoptera), is known from Canada.

Subfamily 2 Encyrtinae Walker

The characters of the subfamily are given in the key to subfamilies of Encyrtidae.

This subfamily encompasses a diversified group divided into 36 world tribes and 30 subtribes (Trypitzin and Gordh 1978*a*). In North America, there are 97 genera (Trypitzin and Gordh 1978*a*) placed in 19 tribes and 29 subtribes. Gordh (1979) included 21 tribes and 112 genera for North America. In Canada, 11 tribes and 49 genera are known.

The subfamily Encyrtinae Walker is separated into three generalized groups based on whether the body is flattened, compact, or elongate. The flat-bodied forms with the mouth parts turned downward and backward (opisthognathous) are represented by *Ixodiphagus* Howard and *Hunterellus* Howard (Ixodiphagini), which are parasites on hardbacked ticks (Ixodoidea), and *Habrolepis* Förster, *Anabrolepis* Timberlake, and *Adelencyrtus* Ashmead (Habrolepidini), which are mainly parasites on diaspine scale insects (Diaspididae, Homoptera).

The elongate body forms are confined to two tribes. The first tribe (Cheiloneurini) is distinguished by the stigmal vein of the fore wing, which is short and straight, by the submarginal vein, which in most instances has a triangular dilation or a bend in the apical third, and by the apex of the scutellum, which often has a cluster of hairs. It comprises nine genera in North America, only one of which is known from Canada, *Cheiloneurus* Westwood, a hyperparasite on Coccoidea (Homoptera) and also Chrysidoidea, on Chalcidoidea, and Apoidea (Hymenoptera).

In the second tribe (Encyrtini), the stigmal vein of the fore wing is curved, the apex of the submarginal vein is not modified, and the apex of the scutellum has a cluster of hairs. The genus *Encyrtus* Latreille is the only representative and is a parasite of coccid scales (Coccidae, Homoptera).

Most encyrtids in North America belong to the genera with compact, or more or less compact, body forms and these are separated into eight groups. The first group (tribe Trechnitini) is distinguished by the strong metallic luster and hyaline wings. It is represented in Canada by three genera: *Prionomitus* Mayr, *Trechnites* Thomson, and *Psyllaephagus* Ashmead; all are parasites of psyllides (Psyllidae, Homoptera).

The second group (tribe Bothriothoracini) is distinguished by the fifth sternite reaching the apex of the gaster, and contains two subgroups. The group is distinguished by the body frequently being coarsely sculptured and sometimes more or less flattened. This is represented in Canada by a single genus, *Bothriothorax* Ratzeburg, a parasite of syrphid flies (Syrphidae, Diptera).

The third group (tribe Homalotylini) is distinguished by the obliquely truncate female antennal club and the mesoscutum with notauli. There are three genera in North America, only two of which are known in Canada: *Homalotylus* Mayr, parasite of coccinellid larvae (Coccinellidae, Coleoptera), and *Isodromus* Howard, parasite of hemerobiid larvae (Hemerobiidae, Neuroptera).

The fourth group (tribe Copidosomatini) is distinguished by the occipital margin being sharp and by the antenna being usually inserted at the mouth margin. These are represented in Canada by five genera: *Copidosoma* Ratzeburg, *Coelopencyrtus* Timberlake, *Paralitomastix* Mercet, *Ageniaspis* Dahlbom, and *Pentacnemus* Howard. They are polyembryonic parasites of various families of Lepidoptera larvae and some bee and wasp larvae (Hymenoptera).

The fifth group (tribe Pseudorphopini) is distinguished by the submarginal vein of the fore wing being short, the postmarginal and stigmal veins rudimentary, the first segment of the mid tarsi short, and the body lacking metallic luster. In North America, only one genus, *Pseudorphopus* Timberlake, is known; it is a parasite of coccid scales (Coccidae, Homoptera).

The sixth group (tribe Aphycini) is distinguished by the body lacking metallic luster (except in *Blastothrix* Mayer), the antenna short, and the mesoscutum sometimes having notauli. In North America, there are 12 genera, of which six are known from Canada: *Blastothrix* Mayer, *Aphycus* Mayr, *Pseudaphycus* Clausen, *Stemmatosteres* Timberlake, *Tetracyclos* Kryger, and *Metaphycus* Mercet. The members of this group have been relatively well studied because they are useful parasites in suppressing harmful scale insects (Compere and Annecke 1969). Gibson and Yoshimoto (1981) redescribed *Tetracyclos boreios* Kryger and discussed its anatomy, its placement, and its association with Pseudococcidae (Homoptera).

The seventh group (tribe Microteryini) is distinguished by the antenna not being broadened, the flagellum uniformly segmented, the periphery of the antennal scrobe rounded, and the mesoscutum without notauli. This tribe is represented in Canada by the following genera: *Tachinaephagus* Ashmead, parasite of Stomoxyidae and Muscidae pupae (Diptera); *Microterys* Thomson, parasite of Coccidae, Dactylopiidae, and Ortheziidae (Homoptera); *Aphidencyrtus* Ashmead, parasite of Aphididae (Homoptera), and hyperparasite on Braconidae and Aphelinidae (Hymenoptera); *Ooencyrtus* Ashmead, egg parasite of Lepidoptera, Neuroptera, Orthoptera, Coleoptera, and Hemiptera; *Pseudencyrtus* Ashmead, parasite of Cecidomyiidae (Diptera), and *Cerchysius* Westwood, parasite of Coleoptera and Diptera.

The eighth group (tribe Arrhenophagini) is distinguished from all other groups by the four-segmented tarsi except in *Tetracyclos boreios* Kryger, which almost certainly is related to *Stemmatosteres* Timberlake (Aphycini). In Canada, there is one genus, *Arrhenophagus* Aurivillius, parasite on Diaspididae (Homoptera).

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Family 6 Signiphoridae

Fig. 32

This family contains small, more or less dorsoventrally flattened forms approximately 1 mm long. They can be separated from other families by the following characters: Body usually shiny, black, or partly yellow to orange. Ocelli widely spaced. Antenna with scape, pedicel, 1–4 anelli, and long cylindrical unsegmented club (Fig. 32). Scutellum and metanotum reduced; scutellum transverse, narrowly ribbonlike. Gaster

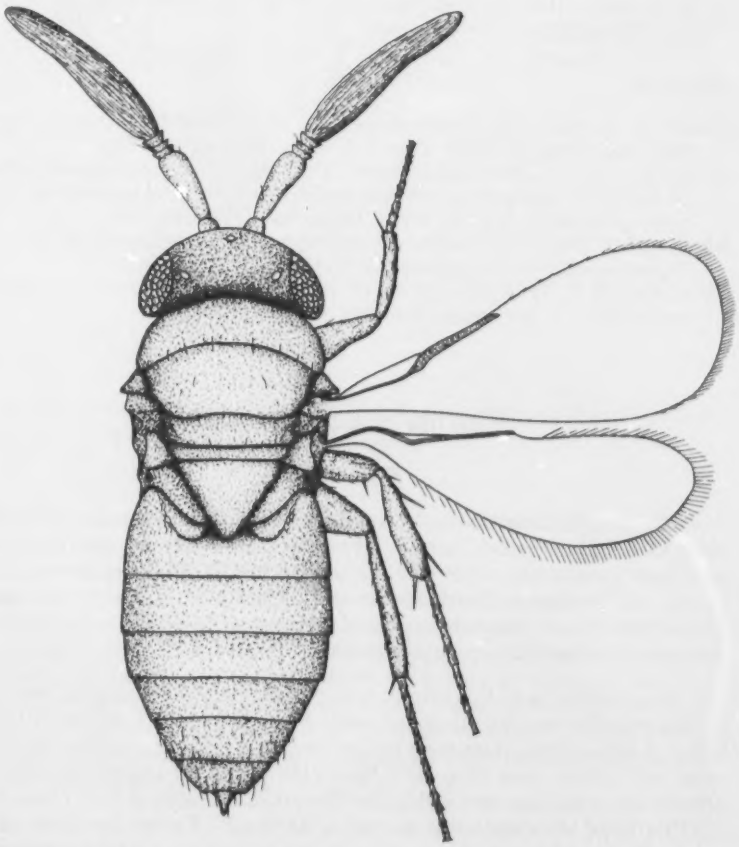

Fig. 32. Family 6 Signiphoridae: female *Signiphora* sp.: dorsal view of habitus.

broadly sessile; propodeum large with large shining median triangular area (Fig. 32). Wings often dark but bare, with long or short marginal setae; venation reduced, with postmarginal vein undeveloped (Fig. 32).

Only three genera, *Signiphora* Ashmead, *Chartocerus* Motschulsky, and *Thysanus* Walker, occur in Canada. These may be identified with the world keys of Rozanov (1965) and Subba Rao (1974), and with the North American keys by Girault (1913) and Quezada, DeBach, and Rosen (1973).

All species are primary and often secondary parasites, mainly of scale insects (Coccoidea) and whiteflies (Aleyrodidae, Homoptera), but also pupal parasites of certain Diptera (for example, Chamaemyiidae and Tachinidae), and jumping plant lice (Psyllidae, Homoptera). Recent studies have shown that some species are primary parasites of diaspine scale insects (Diaspididae, Homoptera).

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Family 7 Eupelmidae

Figs. 33–36

The family Eupelmidae is composed of three subfamilies: Calosotinae, Eupelminae, and Tanaostigmatinae. The Tanaostigmatinae is a southern group and does not occur in Canada. The members of this group can be distinguished from other eupelmids by having two anelli and entire notauli that converge and merge medially before reaching the posterior margin of the mesoscutum.

The members of this family are characteristically elongate and commonly metallic in color; they resemble Encyrtidae in having an enlarged inflated mesopleuron (at least in females) and in having an elongate and stout mid tibial spur (Fig. 35). Riek (1970) placed the eupelmids and aphelinids as subfamilies within the Encyrtidae. Burks *in* Krombein et al. (1979) placed the eupelmids as a separate family. Except for males of the subfamily Eupelminae, the eupelmids can be recognized by the following characters: Mesopleura enlarged, inflated, evenly convex and smooth,

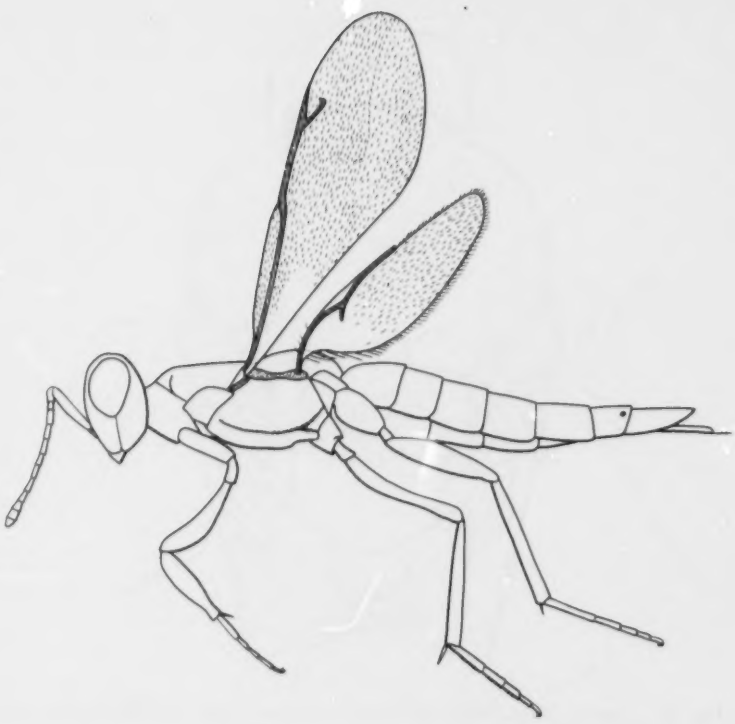

Fig. 33. Family 7 Eupelmidae, subfamily 1 Calosotinae: female *Calosota aestivalis* Curtis: lateral view of habitus.

without impressed lines or grooves (Fig. 35); female notauli not distinct or complete (except for the Tanaostigmatinae); mesosternum elongate, with mid coxae situated near hind coxae, posterior to midline of mesopleura. Wings often reduced, in fully winged forms with marginal vein long. Head and gaster arched upward in dead specimens so that body dorsally concave to U-shaped. Males of the subfamily Eupelminae do not possess the family characteristics as listed above except for an elongate mid tibial spur. The mesopleuron is divided into a mesepisternum and mesepimeron by a femoral groove, and the notauli are entire. In these characters they closely resemble males of the family Pteromalidae, particularly the subfamily Cleonyminae.

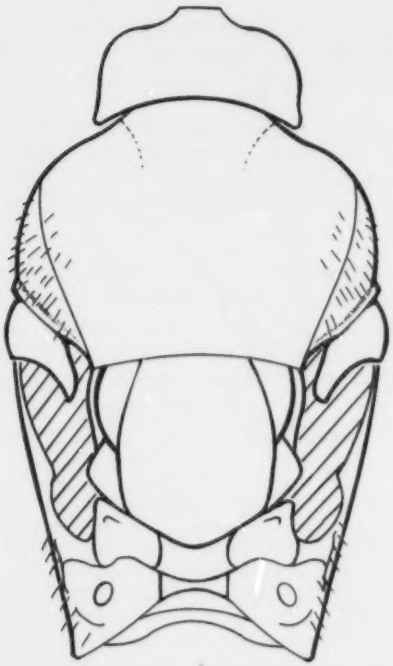

Fig. 34. Family 7 Eupelmidae, subfamily 1 Calosotinae: female *Calosota aestivalis* Curtis: dorsal view of thorax.

Fig. 35. Family Eupelmidae, subfamily 2 Eupelminae: female *Anastatus* sp.: lateral view of habitus with enlargement of mid tarsus.

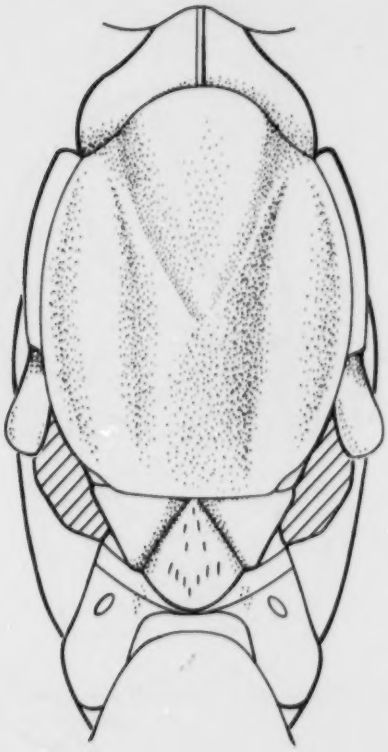

Fig. 36. Family Eupelmidae, subfamily 2 Eupelminae: female *Eupelmus* sp.: dorsal view of thorax.

Key to subfamilies of Eupelmidae

1. Pronotum entire. Mesoscutum broad, subquadrate, with dorsal surface more or less flattened and impressed only near posterior edge, and with anterior part highly convex with lateral corners appearing "shoulderlike" behind much narrower pronotum (Fig. 34); notauli short, linear, particularly in *Eusandalum*, in which they converge and often merge to form an anteromedial triangular region .... **Calosotinae** (p. 59)

   Pronotum most commonly medially divided (Fig. 36). Mesoscutum elongate; dorsal surface of females distinctly depressed or concave, without well-defined notauli (Fig. 36), and with anterior part not highly convex nor much wider than pronotum; notauli distinct, complete ..... **Eupelminae** (p. 60)

Clé d'identification des sous-familles des Eupelmidæ

1. Pronotum entier. Mésoscutum large et presque rectangulaire; la partie dorsale est plus ou moins aplatie et déprimée seulement près du bord postérieur; la partie antérieure est fortement convexe avec les coins latéraux ayant l'apparence d'épaules derrière un pronotum beaucoup plus étroit (fig. 34); notaulices courtes et linéaires, particulièrement chez l'*Eusandalum* chez qui elles convergent et se fusionnent souvent pour former une région antéro-médiane triangulaire .... **Calosotinæ** (p. 59)

Pronotum plus couramment divisé dans la zone médiane (fig. 36). Mésoscutum allongé; la partie dorsale nettement déprimée ou concave chez la femelle et sans notaulices bien définies (fig. 36); la partie antérieure n'est ni très convexe ni beaucoup plus large que le pronotum, et les notaulices distinctes et complètes .... **Eupelminæ** (p. 60)

Subfamily 1 Calosotinae

Figs. 33, 34

Bouček (1958) has proposed the subfamily Calosotinae in the Eupelmidae and provided a key to genera, synonymy, and new combinations of names.

The group is distinguished from the subfamily Eupelminae by the following characters: Pronotum entire, distinctly narrower than thorax, with sides subparallel, thus appearing quadrate (Fig. 34); mesoscutum semiquadrate, with linear and subparallel notauli in *Calosota* and with linear and convergent notauli in *Eusandalum*; axillae reduced, width of medial part of scutellum basally subequal to or greater than width of axilla, and body elongate and slender (Fig. 33), as in many Cleonyminae of the family Pteromalidae. There are two genera and 16 species in North America, of which only *Calosota* Curtis is known from Canada. The genus *Eusandalum* will probably be found in British Columbia.

Burks (1973) has revised the North American species of *Calosota*. Girault (1917) provided a key to the described species of *Eusandalum*.

All known species of *Eusandalum* are parasites on wood-boring Coleoptera (Scolytidae, Cerambycidae). The species of *Calosota* are either primary or secondary parasites of Hymenoptera (Eurytomidae, Torymidae) and Diptera (Cecidomyiidae) in grass stems.

Subfamily 2 Eupelminae

Figs. 35, 36

This subfamily is by far the most common and heterogeneous group of eupelmids in Canada. There are 10 genera and 77 species (Krombein et al. 1979). *Merostenus excavatus* Dalman was introduced into North America but no specimen has been collected since 1924. The genera *Anastatus* Motschulsky, *Arachnophaga* Ashmead, *Eupelmus* Dalman, *Metapelma* Westwood, and *Macroneura* Walker are known from Canada.

Females from the subfamily are easily distinguished from those of the subfamily Calosotinae by the following characters: Pronotum usually medially divided, not distinctly narrower than thorax because its sides converge and do not appear quadrate; mesoscutum longitudinally concave or medially depressed, lacking clearly defined notauli (Fig. 36); axillae often contiguous but this characteristic is also found in Calosotinae; mesopleuron convex (Fig. 35). A number of species have females that are short-winged.

The members of Eupelminae show great diversity in their behavior. Some are primary external parasites of larval or pupal stages of Homoptera, Coleoptera, Diptera, and Lepidoptera. *Anastatus* and some species of *Eupelmus* are egg parasites of Lepidoptera, Orthoptera, and Hemiptera. Others are hyperparasites on Braconidae and Tenthredinidae (Hymenoptera). Some species of *Eupelmus* attack either cynipid gall formers (Cynipidae, Hymenoptera) or Coleoptera and Diptera in plant stems and flower heads. Species of *Metapelma* are parasites of wood-boring beetles (Coleoptera). Members of the genus *Arachnophaga* are either parasites of spiders or primary or secondary parasites of Lepidoptera.

Burks (1967) has revised the North American species of *Anastatus*. Generic classifications of Eupelmidae are given by Ashmead (1904) and Bouček (1958). Gahan (1943) revised the genus *Arachnophaga*.

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Family 8 Eurytomidae

Figs. 37–45

The family Eurytomidae is generally characterized as follows: Body either elongate and slender (most *Harmolita* and some *Eurytoma* species) or small and stocky (most *Bruchophagus* and *Systole* species), largely black, sometimes black and yellow, rarely completely yellowish or with metallic sheen. Wings usually colorless, sometimes partly infuscated. Body surface punctate to rugose, reticulate to smooth, often heavily pitted (Fig. 42); pubescence dense to sparse, short to long. Head transverse, wider than pronotum (Fig. 41); posterior surface of head rounded, or margin of posterior gena laterally carinate or not carinate; mandibles usually with 3 teeth; antenna usually inserted in middle of face (Figs. 37, 38, 42), and scape usually long, extending beyond anterior ocellus; funicle segments of males usually well-developed, as in *Harmolita*, with whorl of long hairs (Fig. 43). Pronotum variable in shape from elongate rectangular to highly transverse; thorax extremely diverse in shape, from elongate in *Harmolita* to stocky in *Eurytoma*; notauli complete and deep (Fig. 41); axillae small; scutellum strongly convex (Fig. 41). Propodeum well-developed, with sculpture distinctive of each species (Zerova 1978). Venation of fore wing diverse. Gaster variable in size and shape, usually laterally compressed, elongate in subfamilies Rileyinae and Harmolitinae and short and round in subfamily Eudecatominae. Ovipositor short. Length of tergites 3 and 4 useful in distinguishing genera.

Burks (1971) revised the world genera of Eurytomidae and gave a generic key for females, treating eight subfamilies and 49 genera. The Palearctic species and genera of Eurytomidae were recently revised by Zerova (1976, 1978), who also gave keys and illustrations for identification. Zerova estimates that there are over 600 known species of eurytomids in the world. Seven subfamilies are represented in Canada.

The members of this family are largely parasitic on many kinds of insects, chiefly on cynipid gall formers, but some are phytophagous, developing either in the seeds of various plants or in grass stems.

Key to subfamilies of Eurytomidae

(After Burks 1971)

1. Genae lacking carinae. Gastral tergites 1–6 or 1–5 subequal in length or tergite 4 longest ..... **Harmolitinae** (p. 63)
Genae laterally carinate (Fig. 39), or if not, then gastral tergites 1–6 or 1–5 not subequal in length 2

2(1). Gaster compressed laterally. Antennal scape extending beyond level of vertex of head ..... **Prodecatominae** (p. 65)
Gaster not compressed laterally, or if so, then antennal scape not reaching or only slightly exceeding level of vertex when raised 3

3(2). Gastral tergite 4, 1.5–2 times as long as tergite 3, or tergite 4 making up half or more of dorsal surface of gaster 4
Gastral tergite 4 subequal to or slightly longer than tergite 3, or shorter than tergite 3 5

4(3). Prepectus reduced, hardly visible, much smaller than tegula (Fig. 39). Antenna of female 13-segmented, with 2 or 3 anelli; antenna of male with funicle segments not notched, without whorl of hairs ..... **Rileyinae** (p. 65)
Prepectus well-developed, distinctly visible, larger than tegula (Fig. 42). Antenna of female 10–12-segmented, with single anellus; antenna of male with funicle segments notched or petiolate, and with whorls of long hairs (Fig. 42) ..... **Eurytominae** (in part) (p. 66)

5(3). Fore wing with marginal vein thickened, usually darkened posterior to marginal vein ..... **Eudecatominae** (p. 69)
Fore wing with marginal vein not thickened, usually not darkened posterior to marginal vein 6

6(5). Posterior margin of scutellum prolonged into long spine extending beyond propodeum, as seen in lateral view (Fig. 43). Basal tergum of gaster extending over most of dorsal surface of gaster (Fig. 43) ..... **Heimbrinae** (p. 68)
Posterior margin of scutellum not modified into spinelike process, or if so, then spine not extending beyond propodeum. Basal tergum of gaster not extending over most of dorsal surface of gaster 7

7(6). Stigmal vein of fore wing longer than marginal vein. Vertex, occiput, and pronotum on same plane; vertex with thornlike projection near eye margin ..... **Aximinae** (in part) (p. 70)
Stigmal vein of fore wing shorter than marginal vein. Vertex, occiput, and pronotum not on same plane; vertex without thornlike projection near eye margin 8

8(7). Anterior ocellus located in scrobe ..... **Aximinae** (in part) (p. 70)
Anterior ocellus located above scrobe ..... **Eurytominae** (p. 66)

Clé d'identification des sous-familles des Eurytomidæ (d'après Burks 1971)

1. Joues sans carène. Les tergites 1-6 ou 1-5 du gastre sont presque de la même longueur ou le tergite 4 est le plus long ..... **Harmolitinæ** (p. 63)

Joues carénées latéralement (fig. 39), sinon, les tergites 1-6 ou 1-5 du gastre sont de longueurs différentes 2

2(1). Gastre comprimé latéralement. Scape des antennes dépassant le niveau du vertex de la tête ..... **Prodecatominæ** (p. 65)

Gastre non comprimé latéralement; si oui, le scape soulevé des antennes n'atteignant pas ou ne dépassant que légèrement le niveau du vertex 3

3(2). Tergite 4 du gastre de 1,5 à 2 fois aussi long que le tergite 3 ou tergite 4 occupant au moins la moitié de la surface dorsale du gastre 4

Tergite 4 du gastre presque égal ou légèrement plus long ou plus court que le tergite 3 5

4(3). Prépectus réduit, à peine visible, beaucoup plus petit que la tegula (fig. 39). Chez la femelle, antennes de 13 articles et de 2 ou 3 annelets; chez le mâle, funicules lisses et antennes dépourvues de touffes de poils ..... **Rileyinæ** (p. 65)

Prépectus bien développé, nettement visible, plus large que la tegula (fig. 42). Chez la femelle, antennes de 10 à 12 articles et d'un seul annelet; chez le mâle, articles du funicule entaillés ou pétiolés et antennes garnies de touffes de longs poils (fig. 42) .... **Eurytominæ** (en partie) (p. 66)

5(3). La nervure marginale de l'aile antérieure épaissie, d'habitude plus foncée postérieurement à la nervure marginale .. **Eudecatominæ** (p. 69)

La nervure marginale de l'aile antérieure non épaissie, d'habitude de la même teinte postérieurement à la nervure marginale 6

6(5). Bord postérieur du scutellum prolongé en une longue épine au-delà du propodéum, en vue latérale (fig. 43). Tergum basal du gastre occupant la majorité de la surface dorsale du gastre (fig. 43) .... **Heimbrinæ** (p. 68)

Bord postérieur du scutellum non modifié en épine; si oui, l'épine ne dépasse pas le propodéum. Tergum basal du gastre n'occupant pas la majorité de la surface dorsale du gastre 7

7(6). Nervure du stigma de l'aile antérieure plus longue que la nervure marginale. Vertex, occiput et pronotum sur le même plan; vertex pourvu d'une projection en forme d'épine près du bord de l'œil .... **Aximinæ** (en partie) (p. 70)

Nervure du stigma de l'aile antérieure plus courte que la nervure marginale. Vertex, occiput et pronotum situés sur des plans différents; vertex sans projection en forme d'épine près du bord de l'œil .. 8

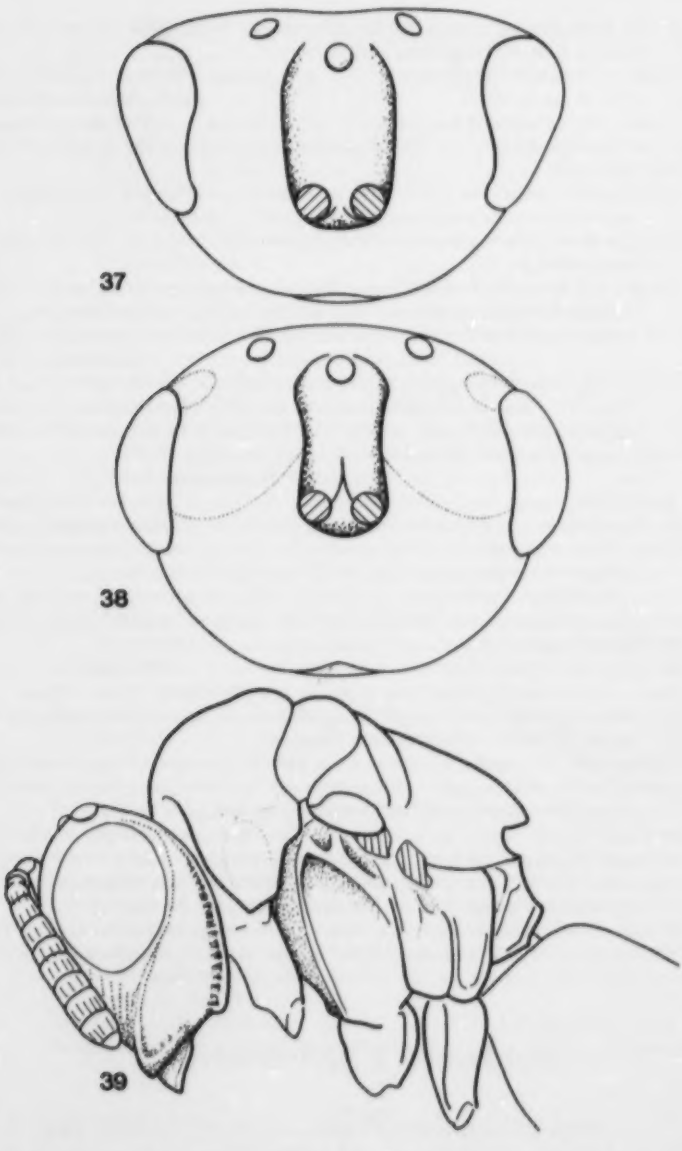
8(7). Ocelle antérieur situé dans le scrobe .... **Aximinæ** (en partie) (p. 70)

Ocelle antérieur situé au-dessus du scrobe ..... **Eurytominæ** (p. 66)

Subfamily 1 Harmolitinae

Fig. 37

The subfamily Harmolitinae in North America consists of five genera, but only *Harmolita* Motschulsky and *Gahaniola* Erdös are known from Canada. The subfamily is distinguished from the other subfamilies by the following characters: Antenna of female with not more than 12 segments (1 anellus, 5 or 6 funicle segments, 2 or 3 club segments);



Figs. 37–39. Family 8 Eurytomidae: 37, subfamily 1 Harmolitinae: female *Harmolita hordei* Harris: frontal view of head; 38, subfamily 2 Prodecatominae: female *Prodecatoma cooki* Howard: frontal view of head; 39, subfamily 3 Rileyinae: female *Rileya cecidomyiae* Ashmead: lateral view of head and thorax.

antenna of male 7-segmented; antennae inserted above or below center of head (Fig. 37); genae not carinate; scape not reaching or only slightly exceeding level of vertex when raised; anterior ocellus located above or within scrobe cavity. Prepectus large, triangular. Gaster cylindrical, with apex not recurved, and with tergites 1–6 or 1–5 subequal in length.

The members of this subfamily are largely associated with monocotyledonous plants. The larvae of *Harmolita* feed on stems of grasses, but most other species make galls. The species of *Gahaniola* feed on stems of reeds and bamboo.

The North American *Harmolita* were revised by Phillips and Emery (1919) and Phillips (1936). Zerova (1976) revised the subfamilies Rileyinae and Harmolitinae for the Palearctic region.

Subfamily 2 Prodecatominae

Fig. 38

This subfamily is represented in Canada by the single genus *Prodecatoma* Ashmead. The members of Prodecatominae differ from other subfamilies by the following characters: Antenna with not more than 12 segments (1 or 2 anelli, 5 funicle segments, 3 club segments); antennae inserted well above center of head or at ventral margin of eyes (Fig. 38); genae laterally carinate; scape extending beyond vertex when raised; anterior ocellus located above or within scrobe cavity. Prepectus triangular. Petiole of gaster short or two times longer than wide; gaster usually dorsoventrally compressed; gastral tergite 4 longest. Submarginal vein 3–3.5 times as long as marginal vein; postmarginal vein not longer than marginal vein; stigmal vein as long as postmarginal vein.

There has been no revision of this subfamily.

The members of this subfamily are parasites of cynipid wasps associated with seeds and plant gails.

Subfamily 3 Rileyinae

Fig. 39

The subfamily Rileyinae in North America is represented by two genera: *Rileya* Ashmead and *Macrorileya* Ashmead. The subfamily can be separated from other groups by the following characters: Antenna 12- or 13-segmented (0–3 anelli, 6–8 funicle segments, 3 club segments); antennae inserted above or below center of head, but always slightly above level of ventral margin of eye; genae laterally carinate (Fig. 39), or not carinate; scape not reaching level of vertex; anterior ocellus located above

scrobe cavity. Prepectus reduced, triangular; scutellum normal. Gaster sessile; gastral tergite 4 or 5 longest. Submarginal vein 1.3–1.5 times as long as marginal vein; stigmal vein one-third to three-fourths as long as postmarginal vein, more or less enlarged in *Rileya*.

The Nearctic species of *Rileya* were revised by Gahan (1918). The species of *Rileya* parasitize gall-forming cecidomyiids (Cecidomyiidae: Diptera), and those of *Macrorileya* parasitize eggs of the cricket *Oecanthus niveus* (De Geer) (Gryllidae: Grylloptera).

Subfamily 4 Eurytominae

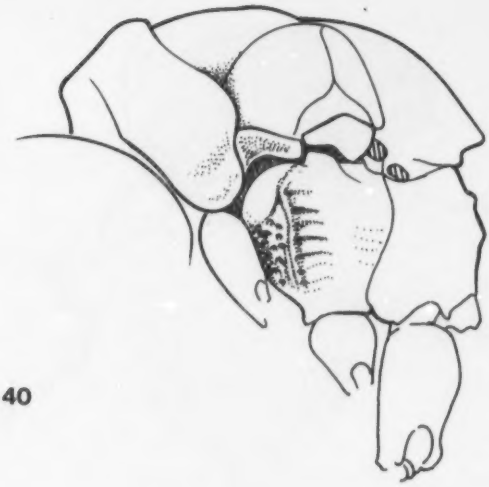
Figs. 40–42

The subfamily Eurytominae is represented in Canada by seven genera: *Bruchophagus* Ashmead, *Eurytoma* Illiger, *Eurytomocharis* Ashmead, *Evoxysoma* Ashmead, *Phylloxeroxenus* Ashmead, *Systole* Ashmead, and *Tenuipetiolus* Bugbee.

The group can be separated from other subfamilies by the following characters: Antenna 12-segmented (1 anellus, 5 funicle segments, 3 club segments); antennae inserted at, below, or above center of head, but always above level of ventral margin of eye (Fig. 37); genae posteriorly carinate; scape almost reaching level of anterior ocellus when raised; male with 4 or 5 funicle segments, some of which are pedunculate (Fig. 42); anterior ocellus located above scrobe cavity. Prepectus triangular or subcrescentic (Fig. 42); scutellum normal (Fig. 41). Petiole variable but usually short. Gaster slender and elongate to laterally compressed; gastral tergite 4 longest, except in *Bruchophagus*, with tergite 3 as long as tergite 4 or slightly longer than tergite 4. Submarginal vein five to six times as long as marginal vein except in *Phylloxeroxenus*, where submarginal vein three times as long as marginal vein; stigmal and postmarginal veins almost equal in length or shorter.

The genera *Eurytomocharis* and *Eurytoma* were revised by Bugbee (1967). The genus *Systole* is now placed in this subfamily (Zerova 1978).

This group has diversified biology and behavior. The genus *Tenuipetiolus* is parasitic on either cecidomyiid (Diptera) or cynipid galls (Hymenoptera). *Phylloxeroxenus* is parasitic on gall-forming cecidomyiids. *Eurytomocharis* is phytophagous on grasses. *Evoxysoma vitis* is the only species of insect reared from seeds of grape; species of *Bruchophagus* are phytophagous on leguminous seeds; species of the large genus *Eurytoma* are generally either primary or secondary parasites but some are entirely phytophagous, whereas others are partly parasitic and partly phytophagous during larval development. *Systole* spp. have been reared from the seeds of Umbelliferae.



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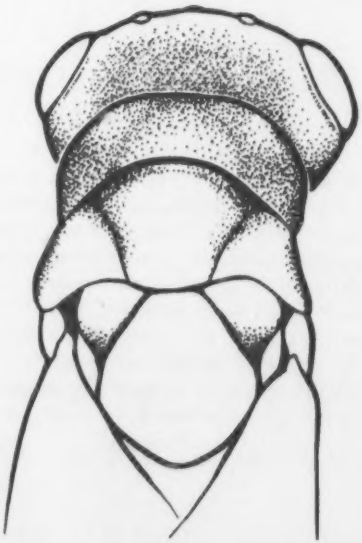

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Figs. 40, 41. Family 8 Eurytomidae, subfamily 4 Eurytominae: 40, female *Eurytoma gigantea* Walsh: lateral view of thorax; 41, male *Eurytoma* sp.: dorsal view of head and thorax.

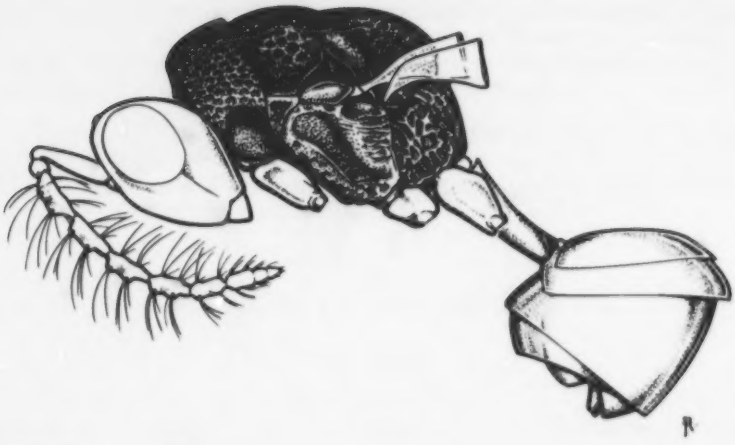


Fig. 42. Family 8 Eurytomidae, subfamily 4 Eurytominae: male *Eurytoma* sp.: lateral view of habitus.

Subfamily 5 Heimbrinae

Fig. 43

The subfamily Heimbrinae is represented in the Nearctic region by a single species, *Heimbra opaca* Ashmead. This species is recognized by the following characters: Antenna 11-segmented (1 anellus, 7 funicle segments, and unsegmented club); antennae inserted at level of ventral margin of eye; genae laterally carinate; anterior ocellus located above scrobe cavity. Prepectus small, rounded, one-third as long as tegula; scutellum produced apically into long, blunt tubercle, projecting over base of gaster (Fig. 43). Petiole not visible; gastral tergite 1 short, fused with tergite 2; gastral tergite 2 longest, covering almost entire gaster. Apex of submarginal vein thickened.

The biology of this species is unknown.

Fig. 43. Family 8 Eurytomidae, subfamily 5 Heimbrinae: female *Heimbra opaca* Ashmead: dorsal view of habitus.

Subfamily 6 Eudecatominae

Fig. 44

In Canada, the subfamily Eudecatominae is represented only by the genus *Eudecatoma* Ashmead. The genus can be separated from other eurytomids by the following characters: Antenna of female not more than 12-segmented (2 anelli, 5 funicle segments, 3 club segments); antenna of

male with 4 funicle segments; antennae inserted at or above level of ventral margin of eye; genae posteriorly not carinate; anterior ocellus located above scrobe cavity; scape reaching level of anterior ocellus when raised. Prepectus triangular. Petiole 1.5–2 times longer than broad; gastral tergite 4 slightly longer than others. Marginal vein short, broad, usually darkened posterior to marginal vein; stigmal vein one-half as long as marginal vein; postmarginal vein absent or, if present, often shorter than marginal vein (Fig. 44).

The species of *Eudecatoma* are worldwide in distribution. In North America, 43 species are known, of which six occur in Canada. Balduf (1932) revised the North American species of *Eudecatoma*.

The species of *Eudecatoma* are largely parasites of cynipid gall formers (Cynipidae: Hymenoptera). A few attack other fall formers, e.g., *Harmolita* (Eurytomidae: Hymenoptera) and *Hemadas* (Pteromalidae: Hymenoptera).

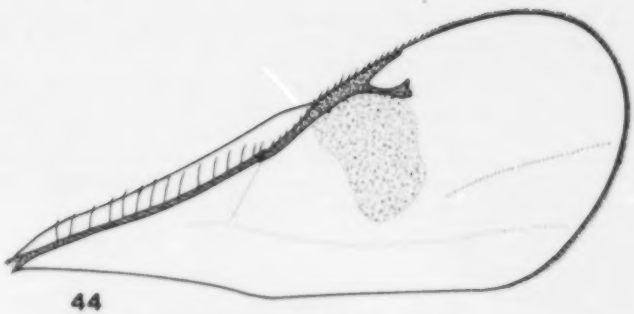
Subfamily 7 Aximinae

Fig. 45

The subfamily Aximinae encompasses a diverse group with four genera: *Ipideurytoma* Bouček & Novicky, *Axima* Walker, *Bephratoides* Brues, and *Chryseida* Spinola. The first three are represented in Canada. This subfamily differs from other subfamilies by the following characters: Vertex, occiput, and pronotum on the same plane, except in *Ipideurytoma*; head broader than thorax; vertex with or without thornlike projection near eye margin (Fig. 45); antenna inserted at, below, or slightly above center of head, but always above level of ventral margin of eye; genae laterally carinate; scape reaching or slightly exceeding level of vertex when raised; anterior ocellus located above or within scrobe cavity. Prepectus triangular; scutellum normal. Petiole long, slender; gaster slender, as long as or longer than head and thorax combined, or as long as thorax and laterally compressed; tergites 3 and 4, or tergite 4, longer than others. Submarginal vein usually two to six times longer than marginal vein; stigmal vein one-half as long as marginal vein (but shorter in *Chryseida*, see Burks (1956)).

There has been no revision of the subfamily Aximinae.

All members of the subfamily are parasitic; *Ipideurytoma* on bark beetles (Scolytidae: Coleoptera); *Axima* on bees of the genus *Ceratina* Latreille (Apidae: Hymenoptera); *Bephratoides* on wood-boring Buprestidae (Coleoptera); *Chryseida* on Bruchidae (Coleoptera).



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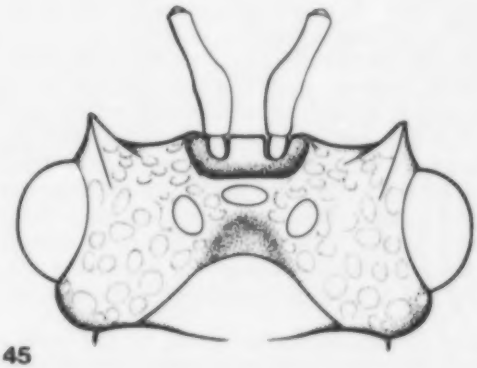

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Figs. 44, 45. Family 8 Eurytomidae: 44, subfamily 6 Eudecatominae: female *Eudecatoma dubia* (Walsh): fore wing; 45, subfamily 7 Aximinae: female *Axima zabriskie* Howard: dorsal view of head.

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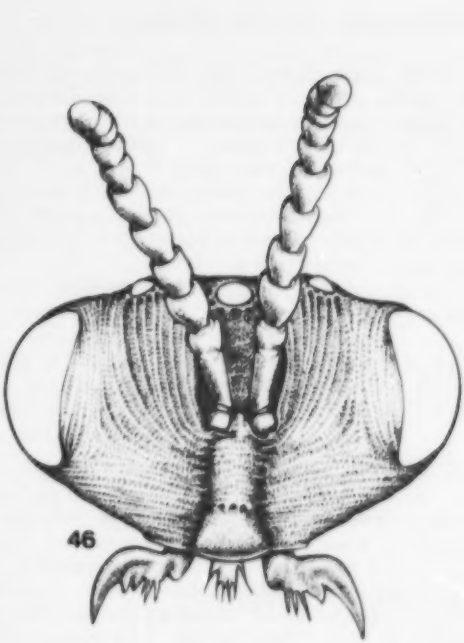
Family 9 Eucharitidae

Figs. 46–48

This family is usually easily recognized by the following characters: Body with distinctive shape (Fig. 48); head narrow, transverse in dorsal view, usually subtriangular in frontal view, relatively small in comparison to thorax. Thorax well-developed, short, and strongly convex to subglobose dorsally (Figs. 47, 48); pronotum reduced, not visible from above; frenulum of scutellum well-developed, sometimes developed as teeth or long apical processes extending over gaster. Gaster usually compressed laterally, rudderlike, usually with long petiole, never sessile (Figs. 47, 48); gastral tergite 1 large, either concealing all other tergites or at least covering most of gaster (Figs. 47, 48). Antennae usually cylindrical or serrate, in males often branched (Fig. 48). Mandibles sickle-shaped (Fig. 46). Prepectus large, sometimes fused with pronotum laterally (Fig. 48).

All members of Eucharitidae for which the hosts are known are parasitic on ants (Formicidae: Hymenoptera). Their biology is discussed by Clausen (1940). The first-instar larvae, like those of Perilampinae, are minute free-living planidia. The adult females oviposit into the buds or foliage of various plants or shrubs away from the actual host ants. Upon hatching, the planidia become active and attach themselves to passing ant workers. In this way they are carried back to the nest, where they transfer themselves to the brood larvae and rest until the prepupal or pupal stage of the host is reached. Development of the parasite then continues to the adult stage. A good description of the life cycle and larval stage of *Pseudometagea schwarzii* (Ashmead) is given by Ayre (1962).



Figs. 46–48. Family 9 Eucharitidae, subfamily 2 Eucharitinae: 46, female *Pseudometagea* sp.: frontal view of head; 47, male *Pseudometagea* sp.: dorsal view of habitus; 48, lateral view of habitus.

Key to subfamilies of Eucharitidae

1. Antennae with 1 or 2 anelli, not branched. Prepectus not fused to pronotum anteriorly. Mesoscutum not greatly expanded. Ovipositor usually extended, wide, scimitar-shaped, with numerous transverse ridges. Body usually blue or metallic green .. **Oraseminae** (p. 74)

Antennae without anelli, branched in some males. Prepectus fused to pronotum anteriorly, or separated by shallow furrow. Mesoscutum large, expanded (Fig. 48). Ovipositor less often extended, long, straight, sometimes with shallow oblique ridges on apex. Body yellow or brown to black, usually without metallic sheen .... **Eucharitinae** (p. 74)

Clé d'identification des sous-familles des Eucharitidæ

1. Antennes pourvues de 1 ou 2 annelets, non ramifiées. Prépectus non fusionné antérieurement avec le pronotum. Mésoscutum pas tellement élargi. Ovipositeur habituellement prolongé, large, en forme de cimeterre et pourvu de nombreuses arêtes transversales. Corps généralement bleu ou vert métallique ..... **Oraseminæ** (p. 74)

Antennes sans annelet, quelquefois ramifiées chez le mâle. Prépectus fusionné antérieurement au pronotum, ou séparé par un sillon peu profond. Mésoscutum large et dilaté (fig. 48). Ovipositeur moins souvent prolongé, long, étroit et parfois pourvu d'arêtes obliques superficielles sur l'apex. Corps jaune ou variant de brun à noir, habituellement sans reflet métallique ..... **Eucharitinæ** (p. 74)

Subfamily 1 Oraseminae

The characters of the subfamily are given in the key to subfamilies of Eucharitidae.

The subfamily Oraseminae is represented by the single genus *Orasema* Cameron, with 16 species in North America.

Gahan (1940) revised the species of *Orasema* for the New World with key to species.

Subfamily 2 Eucharitinae

The characters of the subfamily are given in the key to subfamilies of Eucharitidae.

Six genera of Eucharitinae are recognized in North America, of which *Pseudochalcura* Ashmead, *Pseudometagea* Ashmead, and, probably, *Stilbula* Spinola are known from Canada.

Burks (1961) revised the North American species of *Pseudometagea* Ashmead.

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Family 10 Pteromalidae

Figs. 49–71

Pteromalidae is the largest family of chalcidoids, and has the greatest diversity in size, shape, and biology. Most species are metallic in color and are recognized by the following characters: Head and thorax usually densely sculptured (Fig. 51), with notauli complete (Figs. 57, 61), or incomplete; antennae 11–13-segmented (0–3 anelli, 4–7 funicle segments, 3 club segments) (Figs. 62, 67, 71). Propodeum usually with plicae (sublateral carinae) (Fig. 68), a median carina, and some species with a narrowed convex neck (nucha) extending posteriorly. Some of the smaller pteromalids are superficially similar to the Eulophidae but may be separated by the five-segmented tarsi, by the greater number of antennal segments (11–13), and by the long curved fore tibial spurs.

Males of this family may be confused with those of the genus *Eupelmus* (Eupelmidae), in which the mesopleuron is divided by a distinct suture into mesepisternum and mesepimeron. Pteromalid males can easily be distinguished from *Eupelmus* males, however, by the poorly developed mid tibial spur, which is enlarged and thickened in the latter. Females are indistinguishable.

Key to subfamilies of Pteromalidae

(Partly after Graham 1969)

1. Prepectus firmly fused with pronotum (Fig. 50). Gaster convex, in form of high triangle (Fig. 49) ..... **Perilampinae** (p. 81)
Prepectus not fused with pronotum. Gaster not in form of high triangle 2

2(1). Antenna attached close to clypeus (Fig. 52), 8–10-segmented, without anellus. Body usually not metallic 3
Antenna attached high above clypeus (Figs. 55, 58, 60), or, if antenna attached close to clypeus, then hind femur enlarged with ventral edge serrate, antenna 11–13-segmented (except in Eunotinae 6–10-segmented) and with 0–3 anelli. Body usually metallic 4

3(2). Body entirely black (Fig. 51); head, pronotum, and mesoscutum with conspicuous piliferous punctures ..... **Spalangiinae** (p. 83)
Body entirely or partly yellowish; body lacking piliferous punctures ..... **Cerocephalinae** (p. 84)

4(2). Fore wing with radial cell fully or partly developed (Fig. 53); hind wing without distinct stigma; vein sometimes translucent ..... **Brachyscelidiphaginae** (p. 85)
Fore and hind wings without above combination of characters 5

5(4). Propodeal spiracles situated about midway between anterior and posterior angles of propodeum (Fig. 54). Antennae inserted at each side of clypeus, near mouth edge ..... **Ceinae** (p. 86)
Propodeal spiracles closer to anterior end of propodeum. Antennae inserted far from edge of mouth 6

6(5). Vertex with 6–12 large conspicuous bristles (Fig. 56). Scutellum with 4 long bristles, usually longitudinally marked with parallel fine impressed lines ..... **Diparinae** (p. 86)
Vertex without large conspicuous bristles. Scutellum with 4 or more bristles, usually not longitudinally marked with parallel fine impressed lines 7

7(6). Head crescent-shaped. First tergite large, quadrate, extending over more than half of gaster. Anterior margin of costal cell strongly curved, meeting base of marginal vein, thus appearing as incised (Fig. 57). Scutellum large, usually extending posteriorly beyond base of gaster (Fig. 57) ..... **Eunotinae** (p. 88)
Head not crescent-shaped. First tergite not large and quadrate, extending over less than half of gaster. Anterior margin of costal cell not strongly curved and without incision. Scutellum normal, not extending beyond base of gaster 8

8(7). Notauli of mesoscutum complete (Figs. 4, 61), meeting transcutal suture 9
Notauli of mesoscutum incomplete, not reaching transcutal suture (Fig. 68) 20

9(8). Antennal funicle 7-segmented 10
Antennal funicle 5- or 6-segmented 12

10(9). Mid tarsus of female 4-segmented; fore and hind tarsi 5-segmented. Face of male and female with longitudinal impressed line mesad of malar groove, extending from eye to edge of mouth (Fig. 58) ..... **Macromesinae** (p. 88)

Mid tarsus of both sexes 5-segmented. Face without longitudinal impressed line 11

11(10). Head and thorax yellow and black, not metallic; head projecting forward; postmarginal vein longer than stigmal vein ..... **Miscogastrinae** (in part) (p. 89)

Head and thorax metallic; head not projecting forward (Fig. 61); postmarginal vein short or not developed .... **Eutrichosomatinae** (p. 91)

12(9). Parastigma of fore wing similar in thickness to submarginal vein (Fig. 63). Antennae inserted below to well below ventral margin of eye (Fig. 62) ..... **Asaphinae** (p. 92)

Parastigma of fore wing distinctly different in thickness from submarginal vein (Fig. 65). Antennae usually inserted at or above ventral margin of eye 13

13(12). Antennae 13-segmented, often with 2 anelli and 6 funicle segments (Fig. 68), or 3 anelli and 5 funicle segments 15

Antennae 10–12-segmented, often with 2 anelli and 5 funicle segments, without anellus and with 6 funicle segments, or with 3 or 4 anelli and 3 funicle segments 14

14(13). Hind femora greatly swollen, with ventral serration or dentate. Eyes greatly divergent ventrally. Antennae inserted below ventral margin of eyes ..... **Chalcedectinae** (p. 92)

Hind femora normal, without ventral serration or dentate. Eyes not divergent ventrally. Antennae inserted above ventral margin of eyes ..... **Miscogastrinae** (in part) (p. 89)

15(13). Antennae inserted above middle of face; toruli closer to anterior ocellus than to clypeus (Fig. 64); head subglobose ..... **Panstenoninae** (p. 95)

Antennae inserted below middle of face; toruli halfway between frontal ocellus and anterior margin of clypeus; head not subglobose .. 16

16(15). Marginal vein of fore wing more than 3.5–6 times as long as stigmal vein (Fig. 65). Petiole of gaster distinctly sculptured ..... **Chrysolampinae** (p. 96)

Marginal vein of fore wing at most three times as long as stigmal vein. Petiole, if present, with surface moderately sculptured to smooth 17

17(16). Fore wing with postmarginal vein longer than marginal vein 18

Fore wing with postmarginal vein not longer than marginal vein .. 19

18(17). Prepectus narrow laterally ..... **Pteromalinae** (in part) (p. 96)

Prepectus broad laterally (Fig. 59) ... **Miscogastrinae** (in part) (p. 89)

19(17). Gaster petiolate ..... **Miscogastrinae** (in part) (p. 89)

Gaster sessile or subsessile ..... **Pteromalinae** (in part) (p. 96)

20(8). Head with crests on face and frons (Fig. 69); inner orbits of eyes straight; clypeus with strong radiating striae covering face and genae ..... **Cratominae** (p. 99)

Head without crests on face and frons; inner orbits of eyes not straight; clypeus without strong radiating striae 21

21(20). Antennae 10–12-segmented 22

Antennae 13-segmented 23

22(21). Antennae inserted at or below level of ventral margin of eyes, with or without anelli; club with 2 or 3 segments, not acutely pointed .... **Miscogastrinae** (in part) (p. 89)

Antennae inserted above level of ventral margin of eyes, with 2 or 3 anelli; club solid or with indistinct segments, acutely pointed ..... **Pteromalinae** (in part) (p. 96)

23(20). Hind tibia with 2 apical spurs. Axillae produced forward beyond scutellar base (Fig. 70) ..... **Colotrechinae** (p. 99)
Hind tibia with single apical spur. Axillae rarely produced forward beyond scutellar base (Fig. 68) 24

24(23). Antennae with 1 anellus. Body, including eyes, wings, and gaster, densely hairy. Pronotum as long as broad, narrower than mesoscutum (Fig. 71) ..... **Cleonyminae** (p. 101)
Antennae with 2 or 3 anelli. Body not densely hairy. Pronotum broader than long, narrower than or as broad as mesoscutum (Fig. 68) ..... **Pteromalinae** (in part) (p. 96)

Clé d'identification des sous-familles des Pteromalidæ (partiellement d'après Graham 1969)

1. Prépectus fermement fusionné avec le pronotum (fig. 50). Gastre convexe, en forme de triangle pointu (fig. 49) .. **Perilampinæ** (p. 81)
Prépectus distinct du pronotum. Gastre non en forme de triangle pointu 2

2(1). Antennes insérées près du clypéus (fig. 52), comprenant de 8 à 10 articles sans annelet. Corps habituellement sans couleur métallique 3
Antennes insérées bien au-dessus du clypéus (fig. 55, 58, 60); si elles sont insérées près du clypéus, le fémur postérieur est élargi et dentelé ventralement; antennes de 11 à 13 articles, sauf chez les Eunotinæ (de 6 à 10 articles), pourvues d'au plus 3 annelets. Corps généralement de couleur métallique 4

3(2). Corps entièrement noir (fig. 51); tête, pronotum et mésoscutum garnis de ponctuations pilifères évidentes ..... **Spalangiinæ** (p. 83)
Corps entièrement ou partiellement jaunâtre; corps dépourvu de ponctuations pilifères ..... **Cerocephalinæ** (p. 84)

4(2). Cellule radiale de l'aile antérieure entièrement ou partiellement développée (fig. 53); aile postérieure sans stigma distinct; nervure parfois translucide ..... **Brachyscelidiphaginæ** (p. 85)
Ailes antérieures et postérieures ne présentant pas cette combinaison de caractères 5

5(4). Spiracles du propodéum situés environ à mi-chemin entre les angles antérieur et postérieur du propodéum (fig. 54). Antennes insérées de chaque côté du clypéus, près du bord de la bouche ..... **Ceinæ** (p. 86)
Spiracles du propodéum plus près de l'extrémité antérieure du propodéum. Antennes insérées loin du bord de la bouche 6

6(5). Vertex pourvu de 6 à 12 poils larges et évidents (fig. 56). Scutellum garni de 4 longs poils, en général marqué longitudinalement de fines lignes parallèles creuses ..... **Diparinæ** (p. 86)
Vertex sans poils larges ni évidents. Scutellum garni d'au moins 4 poils, habituellement non marqué longitudinalement de fines lignes parallèles creuses 7

7(6). Tête en forme de croissant. Premier tergite grand, rectangulaire, occupant plus de la moitié du gastre. Bord antérieur de la cellule costale nettement courbé, se fusionnant à la base de la nervure marginale et apparaissant ainsi comme incisé (fig. 57). Scutellum grand, en général prolongé postérieurement au-delà de la base du gastre (fig. 57) .. .. **Eunotinæ** (p. 88)

Tête non en forme de croissant. Premier tergite ni grand ni rectangulaire, n'occupant pas plus de la moitié du gastre. Bord antérieur de la cellule costale ni courbé fortement ni incisé. Scutellum normal, non prolongé au-delà de la base du gastre 8

8(7). Notaulices du mésoscutum complètes (fig. 4, 61), atteignant la suture transcutale 9

Notaulices du mésoscutum incomplètes, n'atteignant pas la suture transcutale (fig. 68) 20

9(8). Funicule de 7 articles 10

Funicule de 5 ou 6 articles 12

10(9). Chez la femelle, tarse médian de 4 articles; tarses antérieur et postérieur de 5 articles. Face du mâle et de la femelle marquée d'une ligne longitudinale située entre le centre de la face et le sillon malaire, se prolongeant de l'œil au bord de la bouche (fig. 58) .... **Macromesinæ** (p. 88)

Tarse médian de 5 articles chez les deux sexes. Face sans ligne longitudinale creuse 11

11(10). Tête et thorax jaune et noir, sans couleur métallique; tête prolongée vers l'avant; nervure postmarginale plus longue que la nervure stigmale ..... **Miscogastrinæ** (en partie) (p. 89)

Tête et thorax de couleur métallique; tête non prolongée vers l'avant (fig. 61); nervure postmarginale courte et non développée .... **Eutrichosomatinæ** (p. 91)

12(9). Parastigma de l'aile antérieure de la même épaisseur que la nervure submarginale (fig. 63). Antennes insérées en-dessous ou nettement en-dessous du bord ventral des yeux (fig. 62) .... **Asaphinæ** (p. 92)

Parastigma de l'aile antérieure nettement pas de la même épaisseur que la nervure submarginale (fig. 65). Antennes habituellement insérées au niveau ou au-dessus du bord ventral des yeux 13

13(12). Antennes de 13 articles et souvent de 2 annelets et de 6 funicules (fig. 68), ou de 3 annelets et de 5 funicules 15

Antennes de 10 à 12 articles et souvent de 2 annelets et de 5 funicules, ou de 3 ou 4 annelets et de 3 funicules, ou de 6 funicules sans annelet 14

14(13). Fémur postérieur très enflé, dentelé ventralement. Les yeux divergent nettement du côté ventral. Antennes insérées sous le bord ventral des yeux ..... **Chalcedectinæ** (p. 92)

Fémur postérieurement normal et lisse du côté ventral. Les yeux ne divergent pas du côté ventral. Antennes insérées au-dessus du bord ventral des yeux ..... **Miscogastrinæ** (en partie) (p. 89)

15(13). Antennes insérées au-dessus du milieu de la face; torulus plus près de l'ocelle antérieur que du clypéus (fig. 64); tête presque globulaire ..... **Panstenoninæ** (p. 95)

Antennes insérées sous le milieu de la face; torulus à mi-chemin entre l'ocelle frontal et le bord antérieur du clypéus; tête non subglobulaire 16

16(15). Nervure marginale de l'aile antérieure plus de 3,5 à 6 fois plus longue que la nervure du stigma (fig. 65). Pétiole du gastre nettement sculpté ..... **Chrysolampinæ** (p. 96)

Nervure marginale de l'aile antérieure au plus 3 fois aussi longue que la nervure du stigma. S'il y a un pétiole, il est lisse ou moyennement sculpté 17

17(16). Nervure postmarginale de l'aile antérieure plus longue que la nervure marginale 18

Nervure postmarginale de l'aile antérieure pas plus longue que la nervure marginale 19

18(17). Prépectus étroit latéralement ..... **Pteromalinæ** (en partie) (p. 96)

Prépectus large latéralement (fig. 59) ..... **Miscogastrinæ** (en partie) (p. 89)

19(17). Gastre pétiolé ..... **Miscogastrinæ** (en partie) (p. 89)

Gastre assez largement ou largement attaché ..... **Pteromalinæ** (en partie) (p. 96)

20(8). Tête pourvue de crêtes sur la face et le front (fig. 69); bord interne de l'œil droit; importantes stries irradiant du clypéus et couvrant la face et les joues ..... **Cratominæ** (p. 99)

Tête dépourvue de crêtes sur la face et le front; le bord interne de l'œil n'est pas droit; aucune strie nette irradiant du clypéus 21

21(20). Antennes de 10 à 12 articles 22

Antennes de 13 articles 23

22(21). Antennes insérées au niveau ou en-dessous du bord ventral des yeux, pourvues ou non d'annelets; massue de 2 ou 3 articles, pas tellement pointue ..... **Miscogastrinæ** (en partie) (p. 89)

Antennes insérées au-dessus du niveau du bord ventral des yeux, pourvues de 2 ou 3 annelets; massue sans articles distincts, ou articles indistincts, très pointue ..... **Pteromalinæ** (en partie) (p. 96)

23(20). Apex du tibia postérieur pourvu de 2 éperons. Axilles dépassant la base du scutellum (fig. 70) ..... **Colotrechinæ** (p. 99)

Apex du tibia postérieur pourvu d'un seul éperon. Axilles dépassant rarement la base du scutellum (fig. 68) 24

24(23). Antennes pourvues de 1 annelet. Corps, y compris les yeux, les ailes et le gastre, densément poilus. Pronotum aussi long que large, plus étroit que le mésoscutum (fig. 71) ..... **Cleonyminæ** (p. 101)

Antennes pourvues de 2 ou 3 annelets. Corps non densément poilu. Pronotum plus large que long, plus étroit ou aussi large que le mésoscutum (fig. 68) ..... **Pteromalinæ** (en partie) (p. 96)

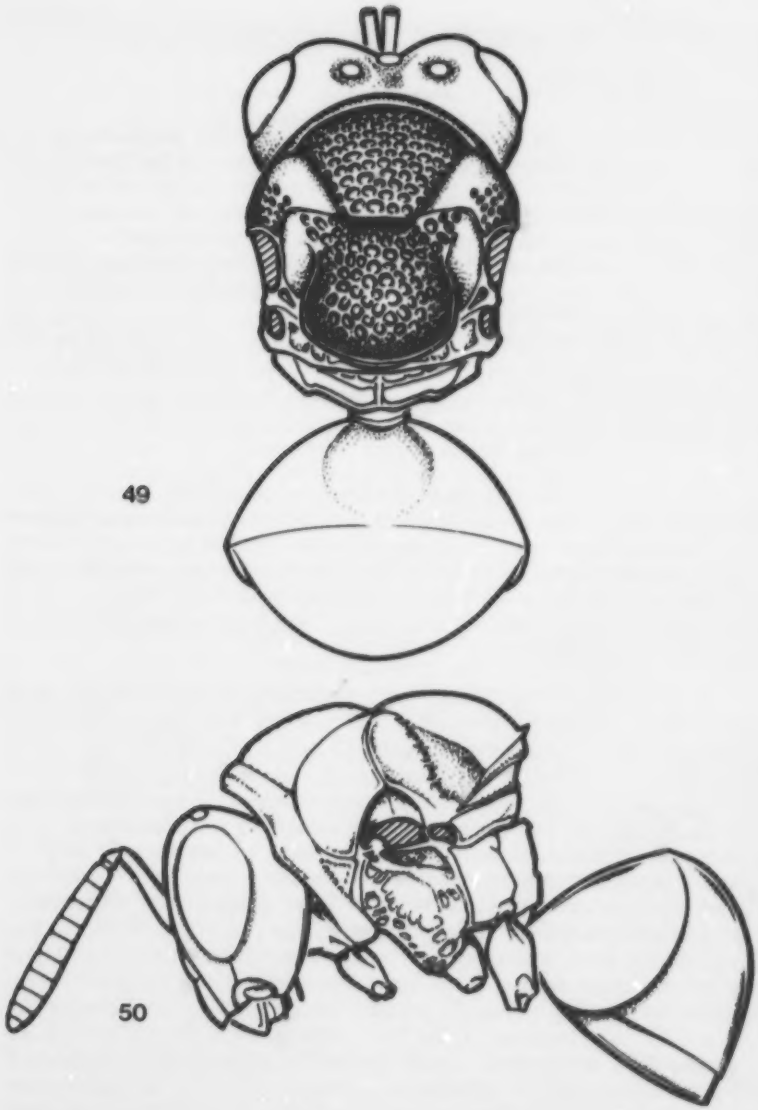
Subfamily 1 Perilampinae

Figs. 49, 50

The subfamily Perilampinae resembles the family Eucharitidae in that the prepectus is fused to and lies in the same plane as the lateral part of the pronotum, and also that the thorax is usually convex and bulging (Fig. 50). The subfamily is recognized by the following characters: Body often 2–3 mm long, robust, sometimes metallic. Pronotum narrow, prominent in dorsal view (Fig. 50). Gaster nearly triangular (except *Steffanolampus* Peck); tergite 1 fused middorsally to tergite 2, with lateral margins free and overlapping (Figs. 49, 50). Thorax frequently with umbilicate or thimblelike punctations (Fig. 49). Gaster subsessile, with short inconspicuous petiole (except for males of *Perilampus fulvicornis* group, i.e., *P. muesebecki* and *P. prothoracius*; *Burksilampus* Bouček is not yet known from Canada); antennae stout, 13-segmented (1 anellus, 7 funicle segments, 3 club segments). Frons deeply depressed.

Four genera of Perilampinae are known from North America; *Perilampus* Latreille, *Euperilampus* Walker, and *Steffanolampus* Peck are known from Canada. These may be distinguished by means of the key to world genera provided by Bouček (1978). The perilampids are given subfamily status by Bouček, following Riek (1966), but as stated by Bouček, "it is premature to discuss their familial rank," and I am treating them as a subfamily of Pteromalidae.

The species of *Perilampus* of North America were revised by Smulyan (1936). Crawford (1916) described eight species and provided a key to known species of *Perilampus* of America north of Mexico. The genus *Steffanolampus* is monotypic, its only species being *S. salicetum* (Steffan), which is a parasite of wood-boring beetles, primarily Anobiidae (Coleoptera). Species of *Perilampus* are hyperparasites on Lepidoptera and Orthoptera (in Canada), and Embioptera and Neuroptera (in tropical regions) through dipterous and hymenopterous primaries. A few species are primary parasites of Hymenoptera (e.g., Diprionidae), Coleoptera (e.g., Curculionidae), or Neuroptera (e.g., Chrysopidae). As in the Eucharitidae the adult females do not lay their eggs directly on the ultimate host, but on plant foliage. First-instar planidiform larvae attach themselves to any moving object. As primary parasites, the planidia enter the host, remain as planidia until the host pupates, then exit from the host, feed externally, and pupate. Those species that are secondary parasites of primary Diptera and Hymenoptera parasites, enter the secondary host larva where they search for and enter the body of the primary parasite. Again, development ceases until the primary parasite exits from the host and pupates. At this time the perilampid parasite takes up an external position on the pupa and continues development (Clausen 1940).



Figs. 49, 50. Family 10 Pteromalidae, subfamily 1 Perilampinae: female *Perilampus hyalinus* Say: 49, dorsal view of habitus; 50, lateral view of habitus.

Subfamily 2 Spalangiinae

Fig. 51

The subfamily Spalangiinae is easily recognized by the following characters: Color shiny black (Fig. 51). Head and dorsum of thorax punctate. Notauli complete. Antennal toruli touching lower edge of face and situated slightly above ventral level of clypeus (Fig. 52); antenna without anellus, with 7-segmented funicle. Hind tibia with single spur. Gaster petiolate.

Fig. 51. Family 10 Pteromalidae, subfamily 2 Spalangiinae: female *Spalangia nigroaenea* Curtis: dorsal view of habitus.

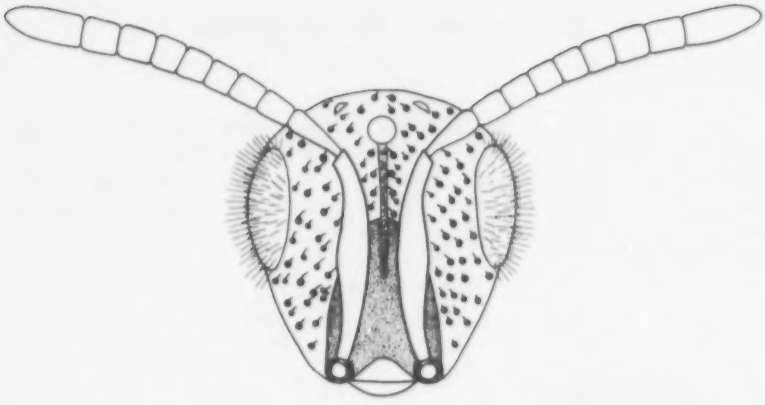


Fig. 52. Family 10 Pteromalidae, subfamily 2 Spalangiinae: frontal view of head.

Bouček (1963) revised the genus *Spalangia* Latreille of the world, and provided keys to Holarctic, Ethiopian, Oriental, and Neotropical species as well as a host–parasite list.

All species of the genus *Spalangia* are parasites of dipterous puparia, e.g., Muscidae, Calliphoridae, Sarcophagidae, Drosophilidae, and Chloropidae, associated with animal manures, carrion, and decaying plant tissues.

Subfamily 3 Cerocephalinae

The North American members of Cerocephalinae are represented by four genera, of which *Choetospila* Westwood and *Cerocephala* Westwood are known from Canada. The members of this subfamily are separated from other genera by the following characters: Head globose or parallel-sided; toruli separated by carina; funicle 5- or 6-segmented, rarely 7-segmented in some males. Fore wing frequently with tufts of hairs at proximal end of marginal vein, usually with two transverse fuscous bands. Scutellum without frenal groove.

Gahan (1946) revised the world Cerocephalinae with a key to the eight known species. Hedqvist (1969) provided a key to 13 genera of Cerocephalini with synonymy, descriptions of new genera and species, distribution, and biological notes on the world species. Grissell (1981)

recognized two species of American *Cerocephala*, both of which are Holarctic in distribution.

All species of this subfamily except one are parasites of Curculionidae, Anobiidae, Bostrichidae, or Scolytidae (Coleoptera).

Subfamily 4 Brachyscelidiphaginae

Fig. 53

The subfamily Brachyscelidiphaginae is represented by a single species, *Hemadas nubilipennis* (Ashmead), in Canada. Riek (1970) placed the subfamily in the family Pteromalidae.

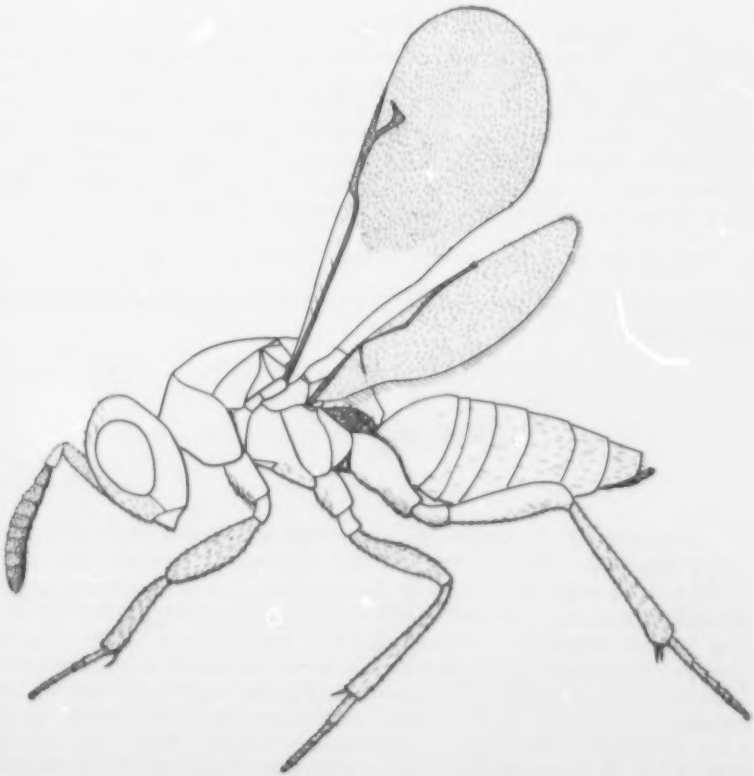


Fig. 53. Family 10 Pteromalidae, subfamily 4 Brachyscelidiphaginae: female *Hemadas nubilipennis* (Ashmead): lateral view of habitus.

This subfamily is distinguished by the following characters: Body generally smooth. Pronotum usually as wide as mesoscutum. Notauli and inner margin of axillae close together. Fore wing with radial cell fully or partly developed, without distinct stigma; basal cell bare or partly developed (Fig. 53); hind wing with basal vein. Hind coxa large, with apical margin exserted.

Gahan and Ferrière (1947) described and keyed the known genera and species of Brachyscelidiphagini.

The members of the subfamily are generally gall formers.

Subfamily 5 Ceinae

Fig. 54

The Canadian members of Ceinae are represented by a single species, *Spalangiopelta ciliata* Yoshimoto (Yoshimoto 1977*a*). The subfamily is distinguished by the following characters: Mandibles bidentate. Antenna 13-segmented (3 anelli, 3 club segments); antenna inserted above and lateral to clypeal margin. Notauli distinct, complete; propodeum subhorizontal, slightly arched, with propodeal spiracles situated halfway between anterior and posterior margins of sclerite (Fig. 54). Petiole distinct. Gaster laterally compressed. Ovipositor prominent.

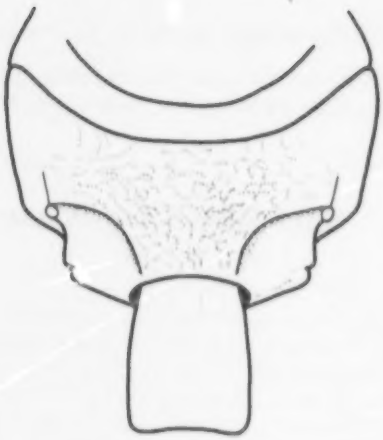
There has been no revision in the Ceinae.

The members of this subfamily are parasites of leaf-mining Agromyzidae (Diptera).

Subfamily 6 Diparinae

Figs. 55, 56

The subfamily Diparinae in North America consists of six genera, of which *Trimicrops* Kieffer, *Dipara* Walker, *Netomocera* Bouček, and *Lelaps* Haliday are known from Canada. This subfamily is distinguished by the following characters: Vertex with 6–12 conspicuous strong dark bristles (Fig. 56); antenna with 1 anellus and 7 funicle segments in female (Fig. 55) (except *Apterolelaps* Ashmead, which lacks an anellus, and *Trimicrops* with 3 anelli), and 1 anellus, 10 subequal flagellar segments, and an undifferentiated club in male. Thorax with sparse, regularly spaced, bristly hairs. Adults sometimes apterous but usually winged. Hind coxa horizontally striate. Gaster conically elongate with gastral tergite 2 about one-half to three-fourths the total length of gaster in females, and tergite 2 nearly covering entire gaster in males.



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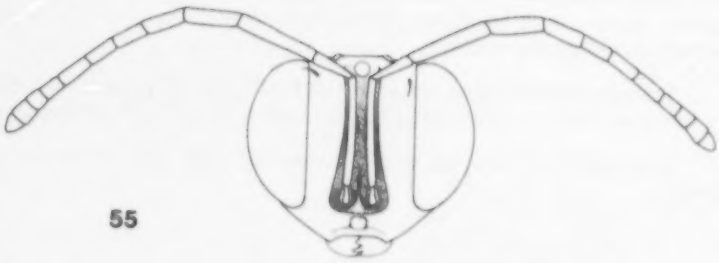

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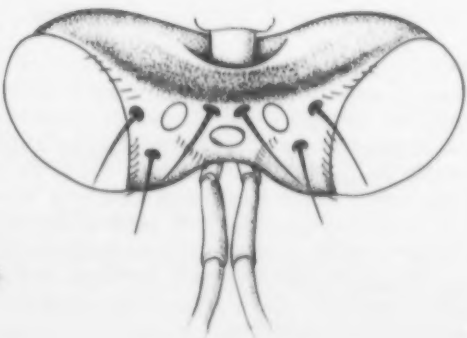

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Figs. 54–56. Family 10 Pteromalidae: 54, subfamily 5 Ceinae: female *Spalangiopelta ciliata* Yoshimoto: propodeum; 55, subfamily 6 Diparinae: female *Lelaps* sp.: frontal view of head; 56, dorsal view of head.

Yoshimoto (1977*b*) revised the North American Diparinae.

The biology of the Diparinae is unknown. The members of this subfamily are possibly parasites of either soil-associated insects or arthropods.

Subfamily 7 Eunotinae

Fig. 57

The North American members of Eunotinae are represented by five genera, of which *Eunotus* Walker and *Scutellista* Motschulsky are known from Canada. This subfamily is distinguished by the following characters: Body robust. Mesonotum, including axillae, in one longitudinal plane and somewhat cylindrically convex. Head wider than thorax (Fig. 57); occiput broadly hollowed, crescentic; antenna with 6–10-segmented (4 or 5 funicle segments), inserted near margin of mouth. Basal tergite of gaster largest, with hind margin straight. Scutellum greatly enlarged, usually overlapping gaster.

The species of Eunotinae parasitize Coccoidea (Homoptera), whereas some species are hyperparasitic through encyrtids (Hymenoptera).

Masi (1931) revised the world Eunotinae with a key to genera and species.

Subfamily 8 Macromesinae

Fig. 58

The subfamily Macromesinae is represented in Canada by a single species, *Macromesus americanus* Hedqvist (Hedqvist 1960). This subfamily is distinguished by the following characters: Antenna 12-segmented (1 anellus, 7 funicle segments, 2 club segments in female, and 7 funicle segments, 3 club segments in males) (Fig. 58). Fore and hind tarsi 5-segmented; mid tarsus 4-segmented and with long basitarsus in female. Inner orbits of eyes strongly divergent posteriorly; supplementary impressed line between malar groove and antennal toruli. Notauli complete; posterior margin of propodeum nearly truncate; postspiracular groove absent or weakly developed. Basal vein of fore wing indicated by oblique pigmented spur from parastigma.

There has been no revision in this subfamily.

The members of this group are parasites of Scolytidae (Coleoptera) on coniferous trees.

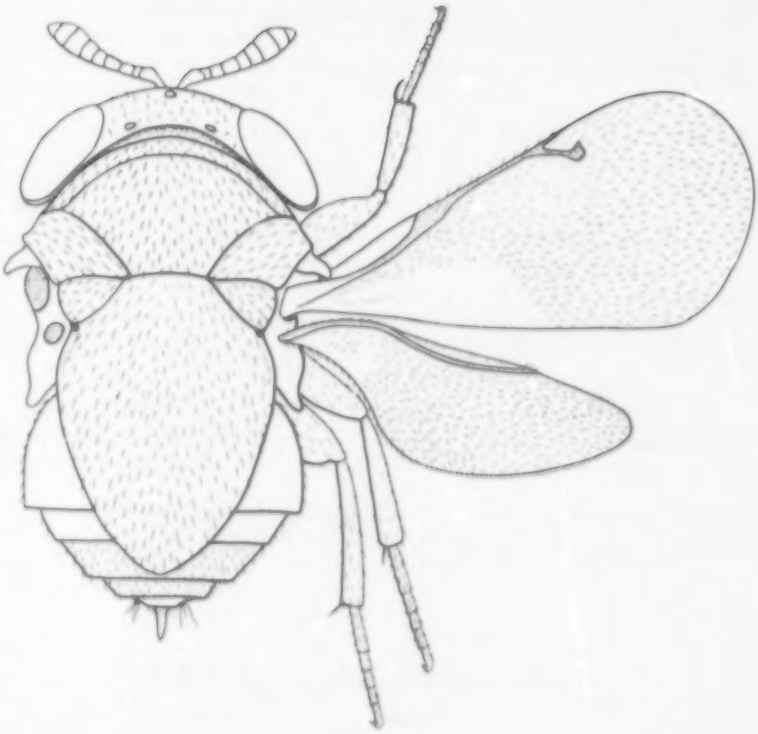
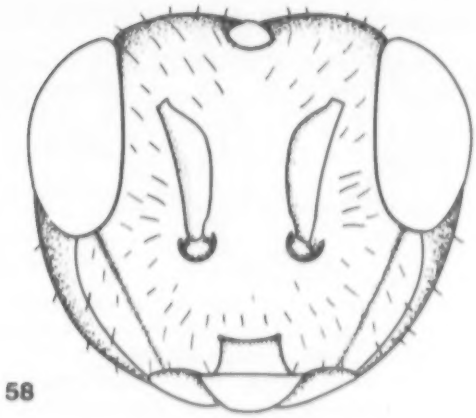


Fig. 57. Family 10 Pteromalidae, subfamily 7 Eunotinae: female *Scutellista* sp.: dorsal view of habitus.

Subfamily 9 Miscogastrinae

Figs. 59, 60

The subfamily Miscogastrinae is the second largest subfamily in Pteromalidae and is divided into six tribes: Micradelini, Pirenini, Ormocerini (= Tridymini), Trigonoderini, Sphegigasterini, and Miscogastrini (Graham 1969). Graham (1969) included a key to the tribes of European Miscogastrinae. The tribal separation is difficult because of many character exceptions in each of the tribes. In general, the members of Miscogastrinae are grouped together by the following characters: Notauli complete. Hind tibia with 2 apical spurs. Gaster petiolate (in most members of Miscogastrini and Sphegigasterini).



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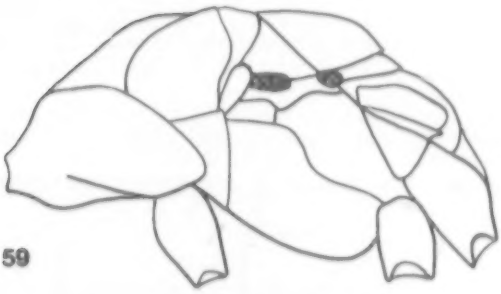

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Figs. 58–60. Family 10 Pteromalidae: 58, subfamily 8 Macromesinae: female *Macromesus americanus* Hedqvist: frontal view of face; 59, subfamily 9 Miscogastrinae: female *Seladerma* sp.: lateral view of thorax; 60, frontal view of head.

The Micradelini can be separated from Pirenini and Ormocerini by the following characters: Postmarginal vein much longer than marginal vein. Speculum absent. Mandibles 2-dentate. Antenna in Pirenini 10-segmented, in Ormocerini 11- or 12-segmented.

In North America, 35 genera and 74 species are placed in the 6 tribes and, of these, 17 genera are known in Canada. The tribes are represented by the following genera: Micradelini by *Micradelus* Walker; Pirenini by *Pirene* Haliday; Ormocerini by *Gastrancistrus* Westwood and *Erixestus* Crawford; Trigonoderini by *Trigonoderus* Westwood, *Janssoniella* Kerrich, *Platygerrhus* Thomson, and *Gastracanthus* Westwood; Sphegigasterini by *Cornura* Walker, *Syntomopus* Walker, *Sphegigaster* Spinola, *Cryptoprymna* Föster, and *Cyrtogaster* Walker; and Miscogastrini by *Lamprotatus* Westwood, *Miscogaster* Walker, *Halticoptera* Spinola, and *Seladerma* Walker (Figs. 59, 60).

Gahan (1934) revised the North American genus *Bubekia* Dalla Torre with several species; Graham (1969) revised *Gastrancistrus* Westwood of northwestern Europe.

The members of the subfamily are parasites of Aphididae (Homoptera), Agromyzidae, Tephritidae, Anthomyiidae, or Cecidomyiidae (Diptera). A few species are parasites of Lepidoptera, Coleoptera, or Hymenoptera.

Subfamily 10 Eutrichosomatinae

Fig. 61

The subfamily Eutrichosomatinae superficially resembles the families Eupelmidae and Pteromalidae (Perilampinae, Cleonyminae, Miscogastrinae, and Pteromalinae), and is known from the New World and Australia.

Two species are represented in Canada, *Eutrichosoma mirabile* Ashmead and *Peckianus laevis* (Provancher) (Bouček 1974). These species can be distinguished from those of other subfamilies by the following characters: Body lacking coarse sculpture, covered with hairs or scalelike hairs (Fig. 61). Head projecting forward; antennae 13-segmented (1 anellus, 7 funicle segments, 3 club segments); antennal scrobe weak, with toruli close to each other and no interantennal ridge. Mesoscutum with shallow complete notauli; axilla advanced forward of scutellar base and separated from both mesoscutum and scutellum by deep arched cross-groove; posterior margin of scutellum slightly overhanging metanotum in nearly vertical manner. Prepectus small laterally, ventrally forming narrow connecting belt. Postmarginal vein of fore wing short or not developed. Tibial formula 1-1-2.

This subfamily was formerly placed as a family until Bouček (1974) reclassified it as a subfamily of the Pteromalidae. Bouček recognized three genera and five species.

Eutrichosoma mirabile Ashmead is a parasite of Curculionidae (Coleoptera).

Subfamily 11 Asaphinae

Figs. 62, 63

The subfamily consists of three genera, but only the genus *Asaphes* Walker is known from Canada. The group is distinguished by the following characters: Head broader than thorax, lenticular; antenna inserted far below middle of face (Fig. 62), 13-segmented (1 or 2 anelli, 6 or 7 funicle segments, 3 club segments). Marginal vein thickened (Fig. 63). Notauli complete. Gaster petiolate; tergites 1 and 2 largest.

Graham (1969) revised this group and provided keys to the European genera and species.

All species are hyperparasites on various species of Aphidiinae (Braconidae: Hymenoptera) in aphids.

Subfamily 12 Chalcedectinae

The subfamily Chalcedectinae in North America consists of one species, *Chalcedectus texanus* (Brues), from Texas. This subfamily is closely related to Cleonyminae (Pteromalidae). In the summer of 1981, Michael Sandborn of McMaster University, Hamilton, Ontario, collected six specimens of a possibly new species of *Chalcedectus* Walker from Hamilton by malaise trap. This is the first record for Canada.

This group is easily recognized from other Pteromalidae by the following characters: Hind femora greatly swollen, with ventral serration or dentate; hind tibia arched as in *Brachymeria* (Chalcididae); fore femur swollen; tibial spur formula 1-1-2. Prosternite flattened. Postmarginal vein two or three times longer than marginal, and stigmal vein short (six times as short as postmarginal vein). Eyes strongly divergent ventrally.

The subfamily Chalcedectinae is generally known from the subtropical and tropical regions.

This group is poorly known and parasitizes wood-boring Coleoptera. Bouček (1959) synonymized six generic names under *Chalcedectus*, and listed 12 known species, largely from the Neotropical region.

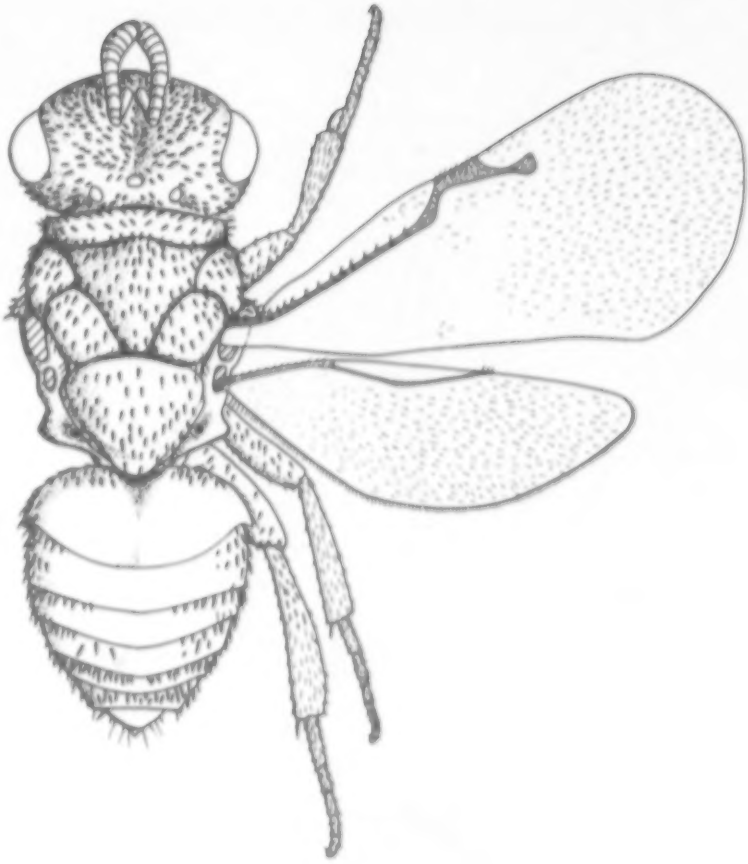
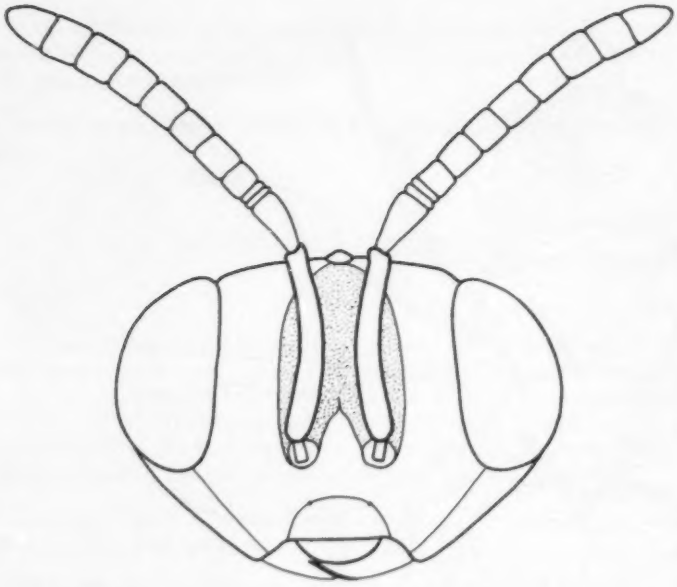


Fig. 61. Family 10 Pteromalidae, subfamily 10 Eutrichosomatinae: female *Eutrichosoma mirabile* Ashmead: dorsal view of habitus.



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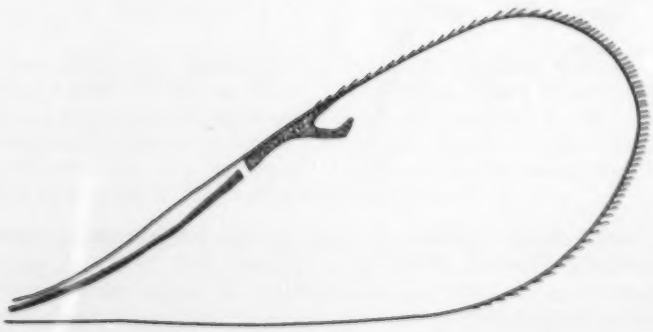

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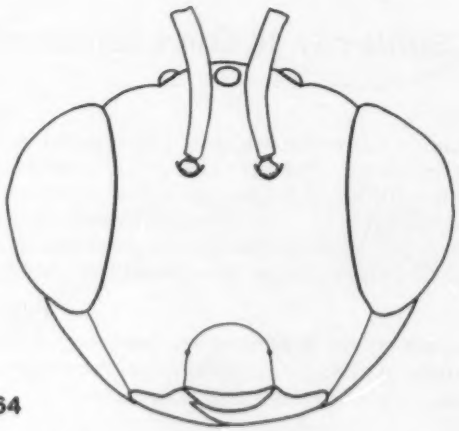
Figs. 62, 63. Family 10 Pteromalidae, subfamily 11 Asaphinae: 62, female *Asaphes vulgaris* Walker: frontal view of head; 63, fore wing.

Subfamily 13 Panstenoninae

Fig. 64

The subfamily Panstenoninae is represented in North America only by *Panstenon columbianum* Ashmead. The subfamily is distinguishable from other subfamilies by the following characters: Head wider than



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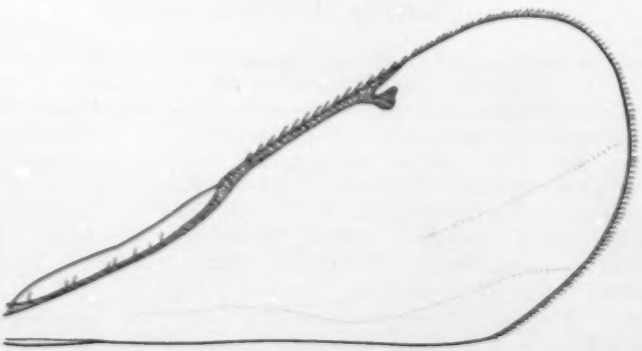

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Figs. 64, 65. Family 10 Pteromalidae: 64, subfamily 13 Panstenoninae: female *Panstenon* sp.: frontal view of head; 65, subfamily 14 Chrysolampinae: female *Chrysolampus* sp.: fore wing.

thorax; antenna inserted high above middle of face; toruli near median ocellus (Fig. 64). Notauli complete or incomplete. Marginal vein of fore wing 4–4.5 times as long as stigmal vein; costal cell 12–20 times as long as its maximum breadth. Legs reddish, except tarsi and trochanter. Petiole and part of gaster sometimes reddish; basal tergite of gaster longest.

There has been no revision in the subfamily Panstenoninae.

This group is known to be parasitic on Delphacidae (Homoptera).

Subfamily 14 Chrysolampinae

Fig. 65

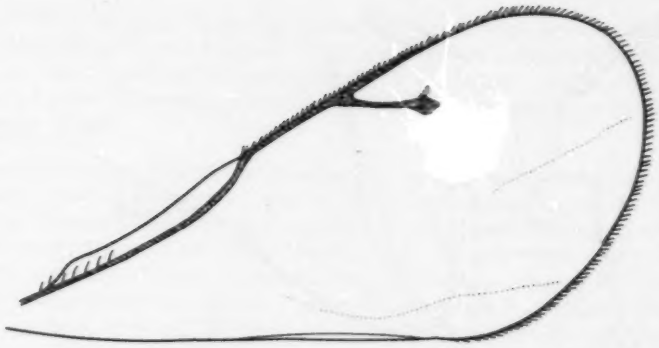
The subfamily Chrysolampinae is represented in Canada by the single genus *Chrysolampus* Spinola. This group resembles the subfamily Perilampinae, but differs in having the following characters: Prepectus separate from mesothorax. Mandibles bidentate. Head broader than thorax. Pronotum margined posteriorly. Stigmal vein subsessile (Fig. 65). Notauli complete. Petiole longer than broad; tergites 1 and 2 covering entire gaster.

The members of the subfamily are parasites of Anobiidae (Coleoptera). In Europe, species of Chrysolampinae parasitize other families of Coleoptera, i.e., Nitidulidae and Curculionidae.

Subfamily 15 Pteromalinae

Figs. 66–68

This subfamily is heterogeneous and also the largest, with 68 genera and 195 species, represented in North America. In Canada, there are 47 genera and 110 species represented by *Dorcatomophaga* Kryger, *Pachyneuron* Walker, *Euneura* Walker, *Pachycrepoideus* Ashmead, *Rhaphitelus* Walker, *Cheiropachus* Westwood, *Dinotiscus* Ghesquière, *Tomicobia* Ashmead, *Rhopalicus* Förster, *Mesopolobus* Westwood, *Platyterma* Walker, *Xenocrepis* Förster, *Coelopisthia* Förster, *Dibrachoides* Kurdjumov, *Belonura* Ashmead, *Trichomalus* Thomson, *Diglochis* Förster, *Tritneptis* Girault, *Dibrachys* Förster, *Trichomalopsis* Crawford, *Lariophagus* Crawford, *Schizonotus* Ratzeburg, *Spaniopus* Walker, *Arthrolytus* Thomson, *Psychophagus* Mayer, *Metastenus* Walker, *Homoporus* Thomson, *Merisus* Walker, *Callitula* Spinola, *Cecidostiba* Thomson, *Catolaccus* Thomson, *Zatropis* Crawford, *Pseudocatolaccus* Masi, *Muscidifurax* Girault & Saunders, *Nasonia* Ashmead, *Dinarmus* Thomson, *Pteromalus* Swederus, *Habrocytus* Thomson, *Lonchetron* Graham, *Anisopteromalus* Ruschka, *Hypopteromalus* Ashmead, *Hemitrichus* Thomson, *Norbanus* Walker, *Lampoterma* Graham,



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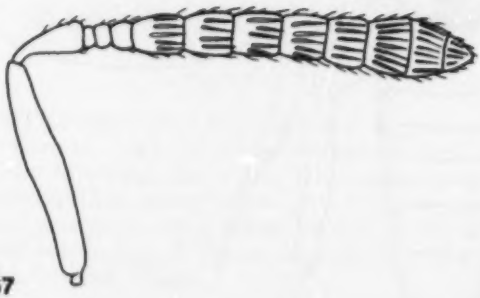

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Figs. 66, 67. Family 10 Pteromalidae, subfamily 15 Pteromalinae: 66, female *Pteromalus* sp.: fore wing; 67, female *Mesopolobus* sp.: antenna.

Neocatolaccus Ashmead, *Capellia* Delucchi, *Arachnopteromalus* Gordh, and *Habritys* Thomson. Under the present classification, Pteromalinae is placed as a single subfamily without tribes. The difficulty with this group lies in its separation from some Miscogastrinae because it requires combinations of several characters for separation. There are always exceptions to the rule (Fig. 67), but generally the members of Pteromalinae have the following characters: Notauli incomplete (Fig. 68). Hind tibia with one apical spur. Petiole sessile or subsessile. Fore wing with marginal vein either not thickened (Fig. 66) or partly to entirely thickened throughout.

In North America, the following pteromaline genera have been revised: *Arthrolytus* Thomson (Burks 1969), *Metacolus* Förster (Burks 1965), *Dinotiscus* Ghesquière (Crawford 1912), *Cheiropachus* Westwood

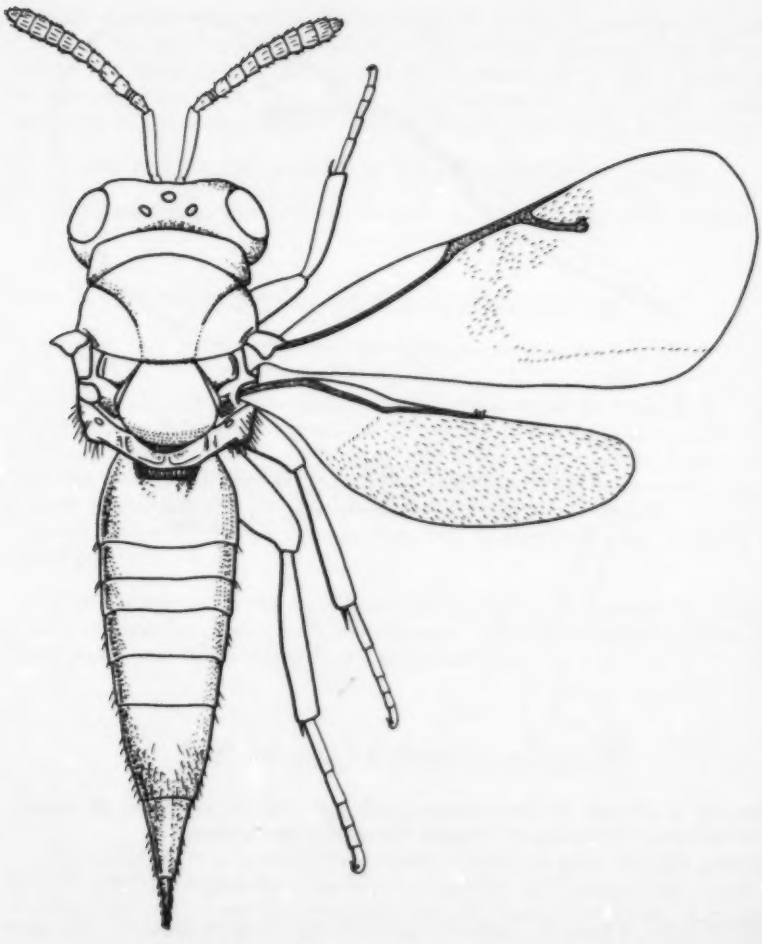


Fig. 68. Family 10 Pteromalidae, subfamily 15 Pteromalinae: female *Habrocytus* sp.: dorsal view of habitus.

(Gahan 1938), *Catolaccus* Thomson (Crawford 1907), *Muscidifurax* Girault & Saunders (Kogan and Legner 1970), *Lariophagus* Crawford (Gahan 1927), *Zatropis* Crawford (Crawford 1921), *Tritneptis* Girault (Burks 1971), *Habrocytus* Thomson (Girault 1917), and *Dorcatomophaga* Kryger (Yoshimoto 1976).

The subfamily is diversified in behavior, and contains species reared from many kinds of insects and other arthropods. Some examples are the following: *Rhopalicus* parasitizes Scolytidae (Coleoptera); *Anisopteromalus* and *Dinarmus* parasitize Bruchidae (Coleoptera); *Pseudocatolaccus* parasitizes Cecidomyiidae (Diptera); *Muscidifurax* and *Nasonia* parasitize Muscidae and Calliphoridae (Diptera); *Tomicobia* parasitizes Scolytidae (Coleoptera); *Trichomalopsis* and *Dibrachys* parasitize Thomisidae (Araneae) and Aphidiidae (Hymenoptera); *Arachnopteromalus dasys* Gordh attacks the egg sac of Uloboridae (Araneae).

Subfamily 16 Cratominae

Fig. 69

The subfamily Cratominae is represented in Canada by the single genus *Cratomus* Dalman. This subfamily is distinguished from other pteromalids by the following characters: Head massive; gena broad; clypeus with radiating striae extending to gena and face; inner orbit of eyes parallel; frons sometimes with hornlike projection (Fig. 69); antenna 8-segmented (without anellus, 3 funicle segments, 3 club segments). Notauli incomplete. Gaster sessile.

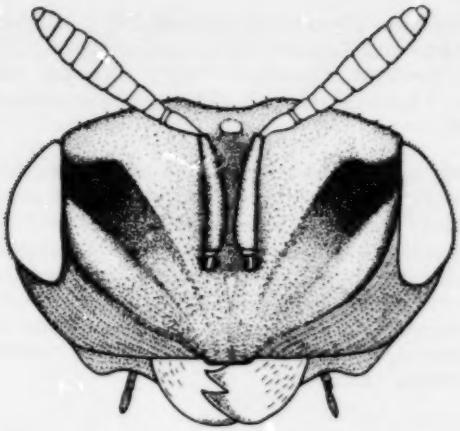
The biology of this subfamily is not known.

Subfamily 17 Colotrechinae

Fig. 70

The subfamily Colotrechinae is represented in Canada by the single species *Colotrechnus (Zanonia) ignotus* Burks (Burks 1958). This species is distinguished by the following characters: Antenna with 2 anelli in female, 3 anelli in male. Scutellum with axillae produced forward far in advance of base of fore wing (Fig. 70). Stigmal vein short, almost sessile; marginal vein three or four times as long as stigmal vein; postmarginal vein short. Hind tibia somewhat compressed, with posterior edge having row of spines with 2 strong apical spurs; hind coxa long (at least three-fourths as long as femur). Spiracle of propodeum touching metanotum. Apical 2 or 3 tergites covered with dark bristles.

Colotrechnus ignotus has been reared from the heads of Compositae (Burks 1958).



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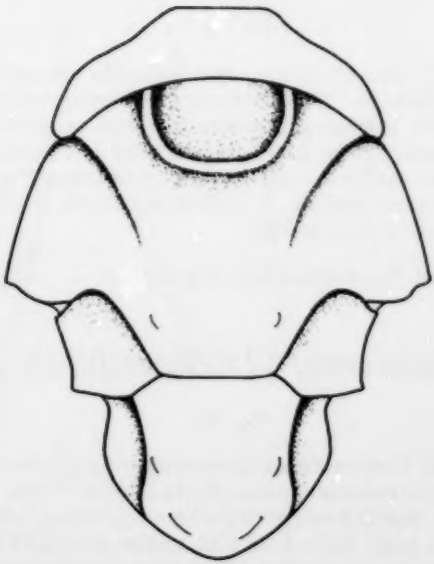

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Figs. 69, 70. Family 10 Pteromalidae: 69, subfamily 16 Cratominae: female *Cratomus* sp.: frontal view of head; 70, subfamily 17 Colotrechinae: female *Colotrechnus (Zanonia) ignotus* Burks: dorsal view of thorax.

Subfamily 18 Cleonyminae

Fig. 71

The subfamily Cleonyminae consists of eight genera and 21 species in North America. The members are usually large and showy pteromalids, and are better represented in subtropical and tropical areas. In Canada, two genera are represented: *Heydenia* Förster and *Ptinobius* Ashmead. This subfamily is close to the subfamily Chalcedectinae and to the family Eupelmidae. Specimens are distinguished by the following characters: Inner margin of eyes strongly diverging on lower part of head; antenna 13-segmented (either 1 annellus and 7 funicle segments (Fig. 71), or without anellus and with 8 funicle segments); mandible bidentate or tridentate. Pronotum large (about one-half length of or equal to mesoscutum). Notauli complete or incomplete. Prepectus relatively large. Fore femur enlarged, with one or more denticles; hind femur sometimes enlarged but without denticles; hind tibia with 2 spurs.

Kerrich and Graham (1957) revised the British and Swedish *Cleonymus* Latreille. Bouček (1958) studied the subfamily Cleonyminae with keys to genera, and with descriptions and notes. There are 40 genera and 170 world species.

The members of this group are parasites of Cerambycidae, Buprestidae, Curculionidae, and Scolytidae (Coleoptera), and of Vespidae and Megachilidae (Hymenoptera).

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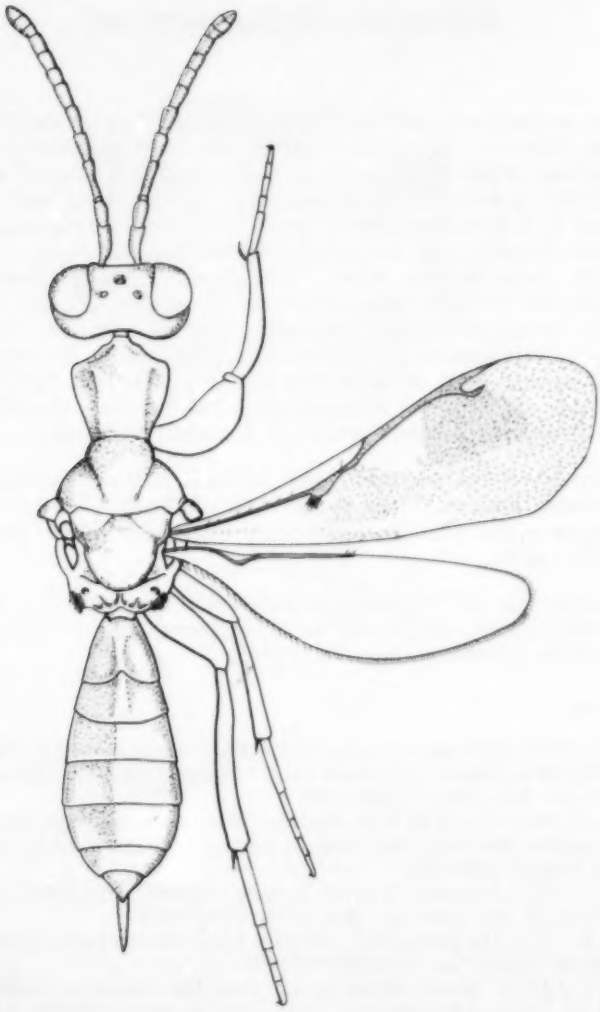

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Fig. 71. Family 10 Pteromalidae, subfamily 18 Cleonyminae: female *Heydenia* sp.: dorsal view of habitus.

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Family 11 Tetracampidae

Fig. 72

This is a small, rare family in North America, though it appears to have been abundant in central North America during the Cretaceous period (Yoshimoto 1975). The only native species of this family is *Epiclerus nearcticus*, described by Yoshimoto (1978) from Canada. One other Canadian species is *Dipriocampe diprioni* (Ferrière), which was introduced in 1936 from Europe to control the European pine sawfly, *Neodiprion sertifer* (Geoffroy) (Hymenoptera). The above two species can be distinguished from each other by the characters given by Yoshimoto (1978). Recently, additional species of *Platynocheilus* Westwood from Waterton Lakes National Park, Alberta, and *Tetracampe* Förster from Carleton Place, Ontario, were collected.

The members of Tetracampidae exhibit characters intermediate between the Pteromalidae and Eulophidae. They are recognized by the following characters: Antenna 11–12-segmented, with single anellus (Fig. 72). Tarsus in both sexes 5-segmented. In some groups of this family tarsus in females 5-segmented, in males 4-segmented; fore tibial spur short, straight. Fore wing with or without speculum, entirely pubescent, with postmarginal vein three times as long as stigmal vein (Fig. 72) (except in males of Platynocheilinae, which have a shorter vein). Propodeum partially or entirely pilose (Fig. 72). The pilosity of the propodeum distinguishes the Canadian Tetracampinae from both the Pteromalidae and Eulophidae.

Bouček (1958) divided the tetracampids into two subfamilies.

Fig. 72. Family 11 Tetracampidae, subfamily Tetracampinae: female *Epiclerus nearcticus* Yoshimoto: dorsal view of habitus.

Key to subfamilies of Tetracampidae

1. Antenna 12-segmented, with antennal ratio 1-1-1-6-3; anellus distinctly longer than broad. Fore wing with speculum; marginal vein in males thickened, sausagelike. Tarsi 5-segmented in both sexes. Body elongate (1.5–5 mm long) ..... **Platynocheilinae** (p. 106)

Antenna 11-segmented, with antennal ratio 1-1-1-5-3; anellus rudimentary. Fore wing entirely pubescent, without speculum; marginal vein not thickened in either sex. Tarsi 4-segmented in male. Body generally stout (2 mm long at most) .... **Tetracampinae** (p.106)

Clé d'identification des sous-familles des Tetracampidæ

1. Antennes de 12 articles, selon le rapport 1-1-1-6-3; annelet nettement plus long que large. Aile antérieure pourvue d'un spéculum; nervure marginale épaissie et en forme de saucisse chez le mâle. Tarse de 5 articles chez les deux sexes. Corps allongé (de 1,5 à 5 mm de longueur) ..... **Platynocheilinæ** (p. 106)

Antennes de 11 articles, selon le rapport 1-1-1-5-3; annelet rudimentaire. Aile antérieure entièrement pubescente, sans spéculum; nervure marginale non épaissie chez l'un ou l'autre sexe. Tarse de 4 articles chez le mâle. Corps généralement trapu (au plus 2 mm de longueur) ..... **Tetracampinæ** (p. 106)

Subfamily 1 Platynocheilinae

The subfamily Platynocheilinae consists of one genus, *Platynocheilus* Westwood, and two species (Bouček and Askew 1968). The characters of the subfamily are given in the key to subfamilies of Tetracampidae. The members of this subfamily are parasites of Agromyzidae (Diptera) and Pteromalidae (Hymenoptera) (Bouček and Askew 1968).

Subfamily 2 Tetracampinae

The subfamily Tetracampinae consists of seven genera and 21 species in the world (Bouček and Askew 1968). The characters of the subfamily are given in the key to subfamilies of Tetracampidae. The members of this subfamily are egg and larval parasites of Chrysomelidae (Coleoptera), Diprionidae (Hymenoptera), and Agromyzidae (Diptera) (Bouček and Askew 1968).

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Family 12 Eulophidae

Figs. 73–83

This is an extensive family. Adults usually have small weakly sclerotized bodies that often collapse and shrivel with drying. This family is distinguished by the following characters: Tarsi 4-segmented. Antenna at most 9-segmented (2–4 funicle segments), sometimes branched in male. Body usually metallic in color and, except for the subfamilies Eulophinae and Entedontinae, with well-developed notauli. Fore tibial spur short, straight, not distinct and curved as in Pteromalidae.

Bouček (1977*a*) and Burks *in* Krombein et al. (1979) placed the tribe Elachertini (formerly arranged as a subfamily) as a tribe of Eulophinae. Graham (1959) gave keys to subfamilies of Eulophidae.

Key to subfamilies of Eulophidae

1. Hind coxa large, triangular, disclike, flattened (Fig. 73). Gaster triangular in cross section or nearly parallel-sided in dorsal view ..... **Elasminae** (p. 108)

   Hind coxa ovate to elongate–ovate. Gaster ovate to elongate–ovate in cross section, usually depressed dorsally 2

2(1). Submarginal vein smoothly joining parastigma. If wing deformed, then axilla not produced forward and notauli present or absent 3

   Submarginal vein disjointed at parastigma. If wing deformed, then axilla angularly produced along base of notauli 4

3(2). Notauli incomplete or faintly indicated in posterior third ..... **Eulophinae** (Eulophini) (p. 110)

   Notauli complete ..... **Eulophinae** (Elachertini) (p. 112)

4(2). Postmarginal vein usually reduced or absent; marginal vein usually somewhat thickened (Fig. 79); scutellum sometimes with 2 longitudinal grooves ..... **Tetrastichinae** (p. 113)

   Postmarginal vein usually longer than stigmal vein; marginal vein usually not thickened (Figs. 76, 77); scutellum without longitudinal grooves 5

5(4). Notauli complete. Axilla angular at anterior margin, and reaching lateral lobe of mesoscutum along notauli. Fore wing usually with hair lines (Fig. 80). Funicle 4-segmented; male antenna usually with whorls of long hairs ..... **Euderinae** (p. 115)

   Notauli incomplete. Axilla rounded at anterior margin, and not reaching lateral lobe of mesoscutum along notauli. Fore wing without hair lines. Funicle 2–4-segmented; male antenna without whorls of long hairs ..... **Entedontinae** (p. 116)

Clé d'identification des sous-familles d'Eulophidæ

1. Coxa postérieur large, triangulaire, en forme de disque et aplati (fig. 73). Gastre triangulaire en section transverse ou à bords presque parallèles en vue dorsale ..... **Elasminæ** (p. 108)
Coxa postérieur ové ou allongé-ové. Gastre allant d'ové à allongé-ové en section transverse, en générale déprimé dorsalement 2

2(1). Nervure submarginale fusionnée au parastigma. Si l'aile déformée, les axilles non développés vers l'avant et notaulices absentes ou présentes 3
Nervure submarginale interrompue au parastigma. Si l'aile est déformée, les axilles forment un angle avec la base des notaulices 4

3(2). Notaulices incomplètes ou à peine apparentes sur le tiers postérieur .. .. **Eulophinæ** (Eulophini) (p. 110)
Notaulices complètes ..... **Eulophinæ** (Elachertini) (p. 112)

4(2). Nervure postmarginale généralement réduite ou absente; nervure marginale en général un peu comme épaissie (fig. 79); scutellum parfois muni de deux rainures longitudinales ..... **Tetrastichinæ** (p. 113)
Nervure postmarginale en général plus longue que la nervure du stigma; nervure marginale en général non épaissie (fig. 76, 77); scutellum sans rainures longitudinales 5

5(4). Notaulices complètes. Axilles angulaires au bord antérieur et atteignant le lobe latéral du mésoscutum le long des notaulices. Aile antérieure habituellement pourvue de lignes de poils (fig 80). Funicule de 4 articles; antenne en général pourvue de touffes de longs poils chez le mâle ..... **Euderinæ** (p. 115)
Notaulices incomplètes. Axilles arrondis au bord antérieur, et n'atteignant pas les lobes latéraux du mésoscutum. Aile antérieure sans lignes de poils. Funicule de 2 à 4 articles; antenne dépourvue de touffes de longs poils chez le mâle ..... **Entedontinæ** (p. 116)

Subfamily 1 Elasminae

Figs. 73, 74

This subfamily has been treated as a family by Graham (1969) and by Bouček *in* Peck et al. (1964). The characters exhibited by elasmines include the following: Tarsi 4-segmented. Axillae produced far forward of scutellum. Funicle 3-segmented in female, 4-segmented in male (basal segments of male funicle bearing 3 lateral branches). Scutellum with 2 pairs of stout bristles. Middle and hind femora enlarged, flattened; legs generally elongate and spiny; hind tibiae with short bristles in longitudinal rows forming elongate to diamond-shaped forms (Fig. 73). Entire body slender and elongate. Gaster appearing wedge-shaped (Fig. 74). Fore wings long and somewhat wedge-shaped, with marginal vein sometimes very long.

Fig. 73. Family 12 Eulophidae, subfamily 1 Elasminae: female *Elasmus* sp.: lateral view of habitus.

Girault (1918) gave a key to the known species of North American *Elasmus* Westwood, and Burks (1965, 1971*b*) revised the North American species of this, the only genus represented in Canada. The species are mainly secondary parasites on Braconidae and Ichneumonidae (Hymenoptera) found in lepidopterous and dipterous primary hosts, though one North American species, *Elasmus polistis* Burks, has been recorded as a primary parasite of *Polistes* Latreille (Hymenoptera: Vespidae).

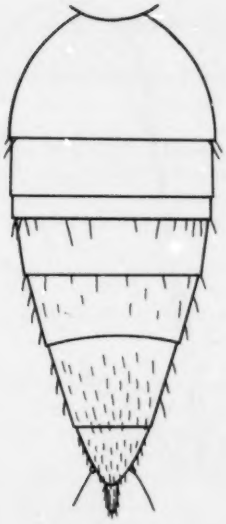


Fig. 74. Family 12 Eulophidae, subfamily 1 Elasminae: female *Elasmus* sp.: dorsal view of gaster.

Subfamily 2 Eulophinae, tribe Eulophini

Figs. 75, 76

The tribe Eulophini consists of moderate-sized species whose bodies are generally bright metallic in color. The members of this group can be identified by the following characters: Head subrectangular, broader than thorax; eyes usually without hairs; antennae usually inserted above level of ventral margin of eyes; male antennae often with 2 or 3 long branches or funicle segments. Notauli incomplete or, if traceable to posterior margin, then shallow and converging posteriorly (Fig. 75); scutellum with 4 bristles. Submarginal vein of fore wing with more than 2 dorsal bristles and without break at parastigma; postmarginal vein never rudimentary, usually at least as long as stigmal vein (Fig. 76). Gaster usually sessile. Ovipositor not protruding apically.

The members of Eulophini are represented in Canada by the following genera: *Pnigalio* Schrank, *Sympiesis* Förster, *Necremnus* Thomson, *Hemiptarsenus* Westwood, *Notanisomorpha* Ashmead, *Diglyphus* Walker, *Eulophus* Olivier, *Dahlbominus* Hincks, *Dimmockia* Ashmead, and *Dicladocerus* Westwood.

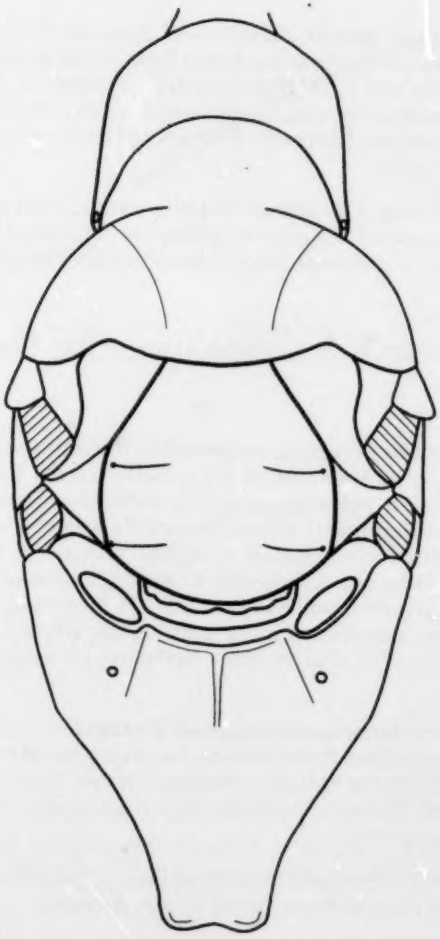


Fig. 75. Family 12 Eulophidae, subfamily 2 Eulophinae, tribe Eulophini: female *Notanisomorpha* sp.: dorsal view of thorax.

The Nearctic genera *Pnigalio* and *Sympiesis* were revised by Miller (1970). Taxonomic notes and a key to New World species of *Diglyphus* are given by Gordh and Hendrickson (1979). Yoshimoto (1976*b*) revised the North American species of *Dicladocerus*. Gahan (1941) revised the world species of *Necremnus* Thomson. Yoshimoto (1983) revised the 17 Nearctic species of *Pnigalio*.

The subfamily Eulophinae contains external parasites of larvae and sometimes pupae of leafminers, primarily Agromyzidae (Diptera), and Gracillariidae, Tortricidae, and Coleophoridae (Lepidoptera).

Subfamily 3 Eulophinae, tribe Elachertini

Fig. 77

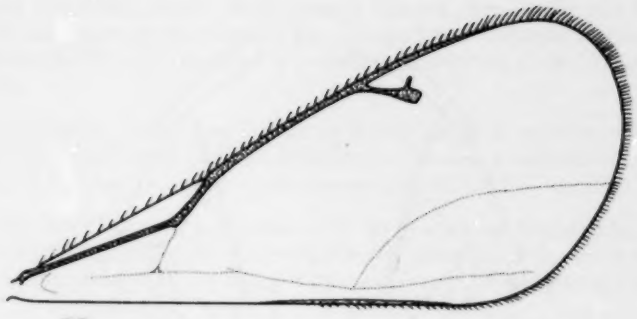
The tribe Elachertini is recognized by the following characters: Moderate-sized species about 2 mm long. Body usually fuscous or brownish and nonmetallic in color. Head usually wider than long and broader than thorax; eyes often hairy; antennae usually inserted above level of posterior margin of eye. Notauli complete and deep. Pronotum usually longer than wide. Scutellum with 4 bristles, and usually with sublateral longitudinal grooves. Submarginal vein of fore wing, with more than 3 dorsal bristles, smoothly joining parastigma; stigmal and postmarginal veins long (Fig. 77). Gaster often petiolate. Ovipositer not protruding apically.

The North American members of Elachertini consist of 18 genera, of which nine are known from Canada, i.e., *Euplectrus* Westwood, *Stenomesius* Westwood, *Elachertus* Spinola, *Hyssopus* Girault, *Pseudolynx* Girault, *Paraolinx* Ashmead, *Giraultia* Gahan & Fagan, *Cirrospilus* Westwood, and *Zagrammosoma* Ashmead.

Girault (1916) revised *Euplectrus*, Gahan (1922) revised *Ardalus*, and Miller (1964) revised *Paraolinx* of North America.

The species of *Zagrammosoma* of North America were revised by Gordh (1978).

The members of this group are mainly larval parasites of Noctuidae, Coleophoridae, Gelechiidae, and Pyralidae (Lepidoptera).



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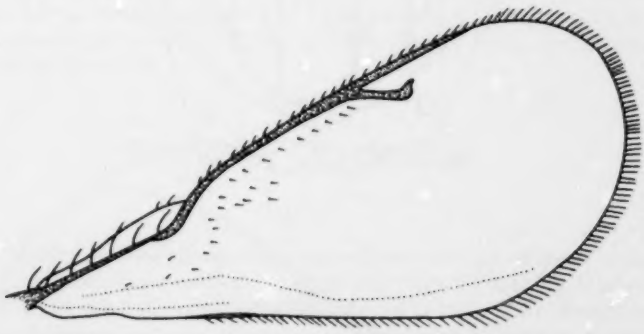

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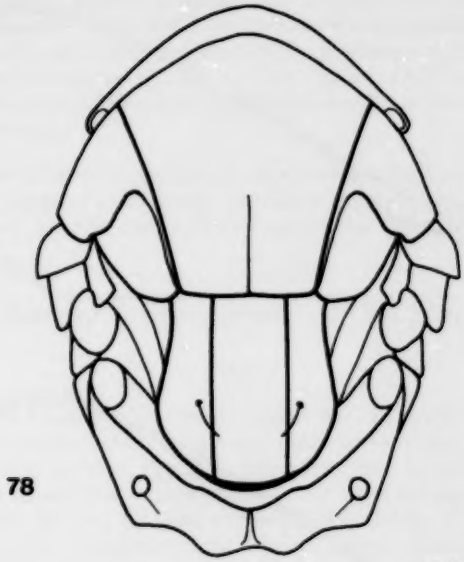
Figs. 76, 77. Family 12 Eulophidae, subfamily 2 Eulophinae: 76, tribe Eulophini: female *Sympiesis* sp.: fore wing; 77, tribe Elachertini: female *Elachertus* sp.: fore wing.

Subfamily 4 Tetrastichinae

Figs. 78, 79

The family Tetrastichinae is composed of moderate-sized wasps whose bodies are usually brown, black, or yellowish with or without metallic reflection. This group can be separated from others by the following characters: Head about equal in length and width, longer than wide, or shorter than wide, more or less convex as seen from dorsal view; eyes usually bare; mandibles bidentate; antennae usually inserted above level of posterior margin of eye; anelli minute, with 3 or 4 segments; antennal funicle 3- or 4-segmented. Notauli usually deep and complete.



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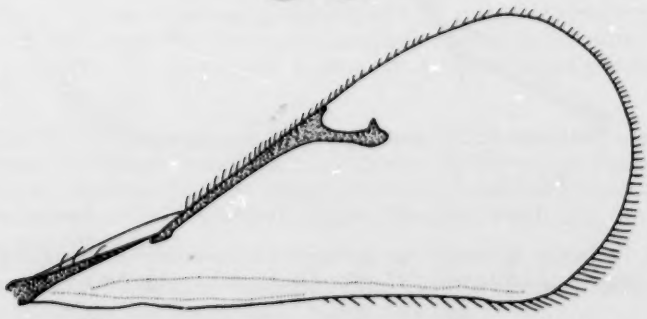

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Figs. 78, 79. Family 12 Eulophidae, subfamily 4 Tetrastichinae: female *Tetrastichus julis* (Walker): 78, dorsal view of thorax; 79, fore wing.

Pronotum short, broad (Fig. 78). Scutellum with 2 bristles and usually with 2 longitudinal grooves. Submarginal vein disjointed at parastigma; marginal vein usually thickened; postmarginal vein reduced or absent (Fig. 79). Gaster sessile. Ovipositor usually short, but long and prominent in *Aprostocetus* Westwood.

The Tetrastichinae are represented by 15 North American genera, of which nine are known from Canada: *Tetrastichus* Walker, *Aprostocetus*

Westwood, *Ceranisus* Walker, *Galeopsomyia* Girault, *Syntomosphyrum* Förster, *Melittobia* Westwood, *Crataepus* Förster, and *Peckelachertus* Yoshimoto. Graham (1975) synonymized *Winnemana* Crawford with *Cirrospilus* Westwood.

The species of *Tetrastichus* Walker of North America were revised by Burks (1943). Yoshimoto (1970*b*) described a species, *Peckelachertus diprioni*, reared from eggs of *Diprion frutetorum* (Fabricius) (Hymenoptera).

Bouček (1977*b*) gave a tentative key to genera of Tetrastichinae. Kostyukov (1977) studied the comparative morphology of the subfamily Tetrastichinae and proposed a key to the subgenera of the genus *Tetrastichus*.

The Tetrastichinae are internal parasites and largely primary parasites of egg, larval, nymph, and pupal stages of many insects. Some are known to be secondary parasites, or hyperparasites. The Nearctic host–parasite names are listed by Burks (1943), Peck (1963), and Burks *in* Krombein et al. (1979).

Subfamily 5 Euderinae

Fig. 80

The subfamily Euderinae comprises an assemblage of small to moderate-sized wasps whose bodies are generally metallic in color. They can be identified by the following characters: Head broader than thorax; eyes bare or with sparse minute pubescence; mandibles bidentate; antennae inserted above level of posterior margin of eyes; anelli minute, with 2

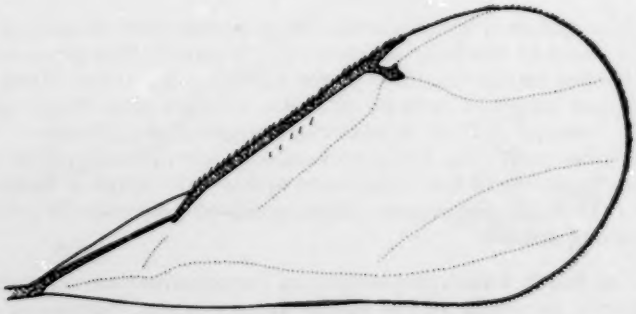


Fig. 80. Family 12 Eulophidae, subfamily 5 Euderinae: female *Euderus albitarsus* (Zett.): fore wing.

segments; antennal funicle 4-segmented; male antennae often with whorls of long hairs. Notauli without carina. Scutellum generally concave, longer than broad, with 4 setae. Propodeum with distinct median carina. Fore wing hyaline, with or without hair lines radiating from stigma (Fig. 80); submarginal vein usually broken at junction of parastigmal vein; marginal vein longer than submarginal vein; postmarginal vein short, subequal or 1.5–2 times longer than stigmal vein; admarginal hairs always present; speculum usually moderate to large. Gaster sessile, usually longer than thorax.

The North American members of Euderinae are represented by four genera, of which two are known from Canada: *Euderus* Haliday and *Astichus* Förster.

The North American species of *Euderus* were revised by Yoshimoto (1971), and are placed in four subgenera, of which *Euderus* (*Secodelloidea* Girault) and *E.* (*Euderus* Haliday) are known from Canada.

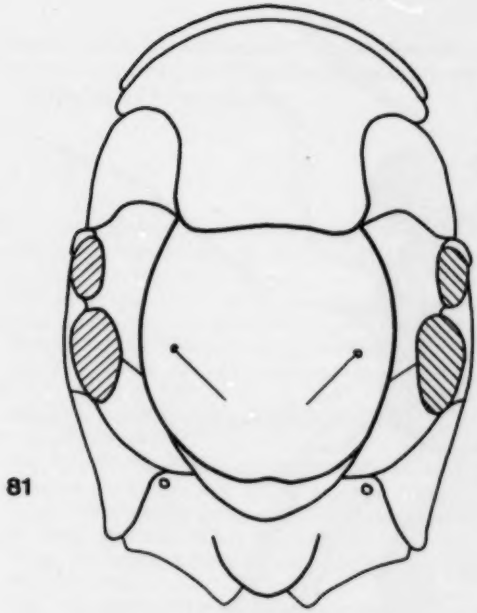
The members of this subfamily parasitize larvae or pupae of leaf-tying and leaf-mining Olethreutidae, Nepticulidae, and Pyralidae (Lepidoptera), of stem-boring Buprestidae, of fungus-inhabiting Erotylidae (Coleoptera), and of gall-forming wasps (Hymenoptera). Some are hyperparasites on other parasitic Hymenoptera. *Astichus polyporicola* Hedqvist (= *notus* Yoshimoto) was reared from woody and birch bracket fungi (Yoshimoto 1970*a*).

Subfamily 6 Entedontinae

Figs. 81–83

The subfamily Entedontinae encompasses small to moderate-sized species about 13 mm long, which are usualy metallic blue green or golden green. They can be identified by the following characters: Head usually wider than long and broader than thorax; eyes often hairy; antennae usually inserted at level of posterior margin of eye. Pronotum usually shorter than wide (Fig. 81). Scutellum with pair of bristles (Figs. 81, 83). Submarginal vein of fore wing more or less interrupted at base of parastigma (Figs. 82, 83). Gaster either sessile or petiolate. Ovipositor not protruding apically.

The North American members of Entedontinae are represented by 24 genera, of which 18 are known from Canada. Yoshimoto (1970*a*, 1970*b*, 1971, 1973*a*, 1973*b*, 1973*c*, 1976*a*, 1977, 1978, 1980, 1981) revised the Nearctic *Chrysocharis* (*Chrysocharis* Förster), *Chrysocharis* (*Nesomyia* Ashmead), *Mestocharis* Förster, *Achrysocharoides* Girault, *Chrysonotomyia* (*Chrysonotomyia* Westwood), *Chrysonotomyia* (*Achrysocharella* Girault), *Thripoctenoides* Erdös, and *Derostenus* Westwood. Burks (1966, 1971*a*) revised



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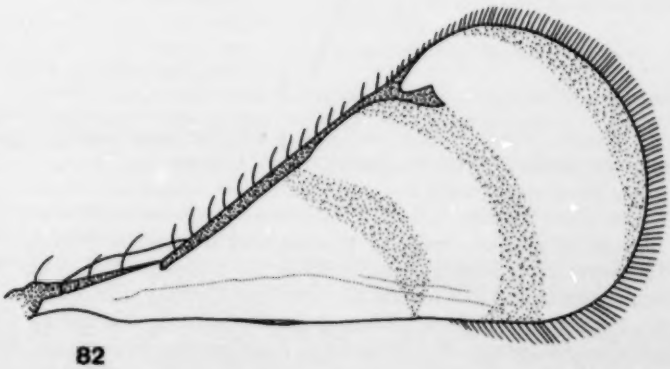

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Figs. 81, 82. Family 12 Eulophidae, subfamily 6 Entedontinae: female *Closterocerus tricinctus*: 81, dorsal view of thorax; 82, fore wing.

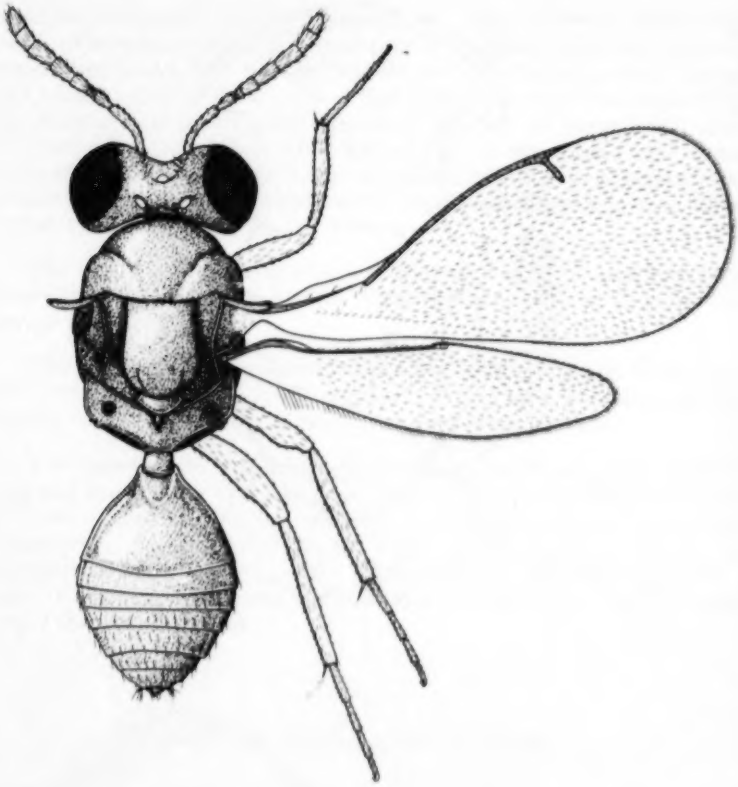

Fig. 83. Family 12 Eulophidae, subfamily 6 Entedontinae: female *Chrysocharis (Chrysocharis) clarkae* Yoshimoto: dorsal view of habitus.

the species of genera *Pediobius* Walker and *Horismenus* Walker. Miller (1962) revised *Achrysocharoides* Girault (= *Enaysma* Delucchi). Other genera represented in Canada are *Omphale* Haliday, *Closterocerus* Westwood, *Emersonella* Girault, *Rhicnopeltoidea* Girault, *Carlyleia* Girault, *Hoplocrepis* Ashmead, *Neochrysocharis* Kurdjumov, *Horismenus* Walker, *Pediobius* Walker, *Entedon* Dalman, and *Paracrias* Ashmead. Grissell (1981) described *Edovum puttleri* from Colombia, South America, which was introduced in 1981 into North America for the control of Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Coleoptera).

The subfamily contains internal parasites of the larval and pupal stages of a large variety of hosts, mainly leaf-mining Nepticulidae and Coleophoridae (Lepidoptera), and Agromyzidae (Diptera) larvae. Some

species are known to be hyperparasites on Braconidae (Hymenoptera) larvae. A few species are egg parasites of Araneidae (Araneae). Others are parasites of Thripidae (Thysanoptera).

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Family 13 Aphelinidae

Figs. 84, 85

The family Aphelinidae consists of 41 known genera and some 700 described species (Rosen and DeBach 1979), and Hayatt (1983) revised the world genera of Aphelinidae and included 44 valid genera. Of these, 20 genera and 120 species are known in North America. This family has provided many biological control agents. They are small nonmetallic yellowish to black insects, mostly about 1 mm long, and the body is frequently very stout and short, with a broad gaster.

Members of this family sometimes closely resemble either trichogrammatids or encyrtids. They may be distinguished from Trichogrammatidae by the following characters: Tarsi 4- or 5-segmented. Marginal vein in fore wing long. Mid tibial spurs long but not thickened. Mesopleuron divided by suture into mesepisternum and mesepimeron except in the genus *Centrodora* Förster and in other related genera. *Centrodora* Förster and other related genera are the only atypical genera of the Aphelinidae and, because of the preceding characteristic, it bears a close resemblance to the Encyrtidae and Eupelmidae. The aphelinids can be distinguished from the Encyrtidae by venational characters, and from the Eupelmidae by the following characters: Antennae not more than 8-segmented (Fig. 84). Eyes large. Pronotum short. Notauli distinct (Fig. 84).

The aphelinids have been variously placed among the Eulophidae and Encyrtidae, or as the family Aphelinidae (Rosen and DeBach 1979). The classification scheme of Yasnosh (1979) is based on the biological approach. Its usage is limited because of the overlapping of host preference between subfamilies and diversity of hosts within the subfamilies. The morphological characters do not correspond with Yasnosh's biological approaches.

Rosen and DeBach (1979) recognized three subfamilies, Aphelininae, Coccophaginae, and Calesinae in the family Aphelinidae. Their monograph of the *Aphytis* of the world is based on biology, host preference, and minute differences in anatomy for species separation.

I agree with Compere and Annecke (1961), Rosen and DeBach (1979), and Hayatt (1983) that Aphelinidae should be considered a distinct family. In the subfamily classification, I follow De Santis (1946, 1948, 1967) and Rosen and DeBach (1979) in dividing the North American representatives into two subfamilies, Aphelininae and Coccophaginae.

Some useful papers on this family are by Compere (1936), Ferrière (1965), Nikol'skaya and Yasnosh (1966), Yasnosh (1976), Rosen and DeBach (1979), and Hayatt (1983).

Key to subfamilies of Aphelinidae

1. Fore wing with oblique bare strip (speculum) below stigmal vein (Fig. 84). Antennae 4–6-segmented ..... **Aphelininae** (p. 122)
Fore wing without oblique bare strip (Fig. 85). Antennae usually 7–9-segmented ..... **Coccophaginae** (p. 123)

Clé d'identification des sous-familles des Aphelinidæ

1. Aile antérieure pourvue d'une bande nue oblique (spéculum) sous la nervure du stigma (fig. 84). Antennes de 4 à 6 articles ..... **Aphelininæ** (p. 122)
Aile antérieure sans bande nue oblique (fig. 85). Antennes habituellement de 7 à 9 articles ..... **Coccophaginæ** (p. 123)

Subfamily 1 Aphelininae

Fig. 84

The subfamily Aphelininae consists of small to minute forms ranging from 0.5 to 2.0 mm long. This group is separated from the other subfamily by the following characters: Mandibles tridentate or bidentate; antennae 3–6-segmented (0–3 funicle segments, 1 club segment). Fore wing with bare oblique band (Fig. 84); marginal vein as long as or longer than submarginal vein; stigmal vein very short; postmarginal vein absent. Tarsi 5-segmented.

The North American members of Aphelininae are represented by five genera, of which *Marietta* Motschulsky, *Aphytis* Howard, *Aphelinus* Dalman, and *Centrodora* Förster (= *Tumidiscapus* Girault) are known from Canada.

The members of this group are primary external parasites (e.g., *Aphelinus*) of aphids (Homoptera: Aphididae), hyperparasites (e.g., *Marietta*) on hymenopterous parasites of scale insects (Homoptera: Coccoidea), egg parasites (e.g., *Centrodora*) of tettigoniids (Orthoptera: Tettigoniidae) and of cercopids (Homoptera: Cercopidae), and pupal parasites (e.g., *Centrodora*) of cecidomyiids (Diptera: Cecidomyiidae).

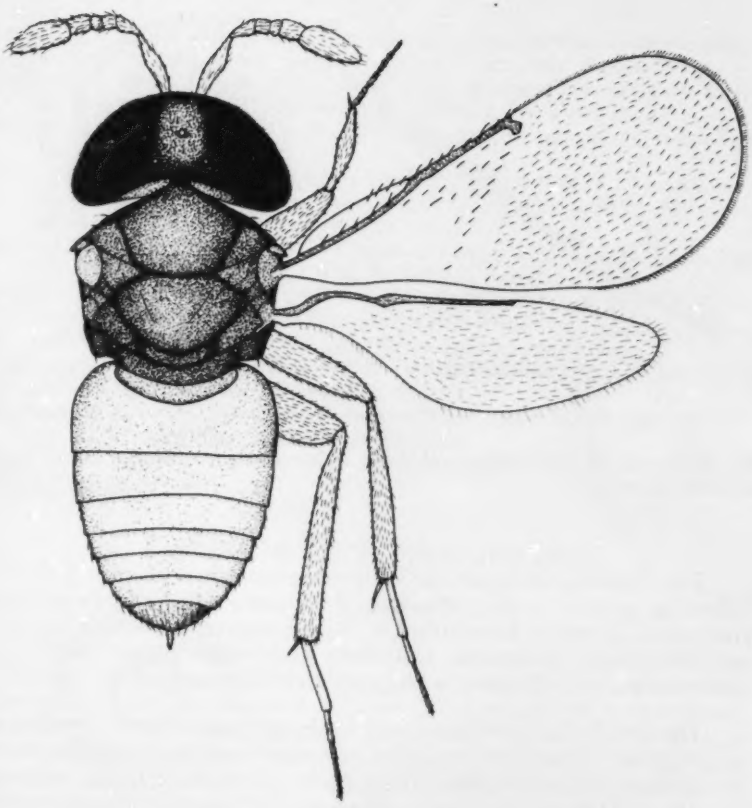

Fig. 84. Family 13 Aphelinidae, subfamily 1 Aphelininae: female *Aphelinus* sp.: dorsal view of habitus.

Subfamily 2 Coccophaginae

Fig. 85

The subfamily Coccophaginae has 10 Nearctic genera. It differs from other subfamilies by having the following characters: Mandibles tridentate; antennae 7–9-segmented (scape, pedicel, 3 funicle segments, 1–3 club segments). Fore wing pubescent, without speculum (bare area) (Fig. 85); marginal vein distinctly longer than submarginal vein; stigmal and postmarginal veins very short. Tarsi 4- or 5-segmented.

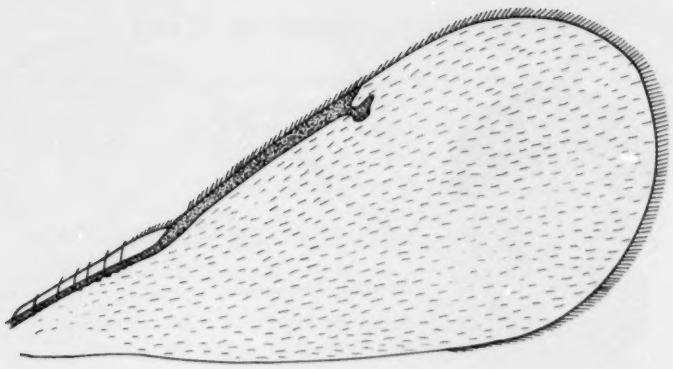

Fig. 85. Family 13 Aphelinidae, subfamily 2 Coccophaginae: female *Coccophagus* sp.: fore wing.

The Canadian members of Coccophaginae are represented by the following genera: *Azotus* Howard, *Archenomus* Howard, *Eretmocerus* Haldeman, *Coccobius* Ratzeburg (= *Physcus* Howard), *Encarsia* Förster, and *Coccophagus* Westwood. *Prospaltella* and *Aspidiotiphagus* have been synonymized with *Encarsia* by Viggiani and Mazzone (1979).

The members of Coccophaginae are hyperparasites on hymenopterous parasites (Hymenoptera: Aphelinidae) of hard scales (Homoptera: Diaspididae) and white flies (Homoptera: Aleyrodidae), and internal primary parasites of hard scales (Homoptera: Diaspididae), soft scales (Homoptera: Lecaniidae), and mealybug scales (Homoptera: Pseudococcidae). A number of species are widely used in biological control of pest insects of economic importance.

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Family 14 Trichogrammatidae

Fig. 86

Members of this family are small, ranging from 0.17 to 1.6 mm long. They are distinguished from all other chalcidoids by the following characters: Tarsi 3-segmented. Fore wings frequently with longitudinally radiating rows of setae (as in some Euderinae) (Fig. 86). Fore tibial spur short, straight, without strigil. Gaster broadly joined to thorax, penetrated by large muscle. Flagellum short, no more than 7-segmented (at most 2 funicle segments, 1 or 2 anelli, 1–5 club segments (Fig. 86)).

The family is distinct and widely separated from the nearest relative, Eulophidae. It is represented in North America by 17 genera, which can be identified by means of the key to world genera and subgenera by Doutt and Viggiani (1968). Only six genera are known from Canada: *Trichogramma* Westwood, *Hydrophylita* Ghesquière, *Oligosita* Walker, *Aphelinoidea* Girault, *Paracentrobia* Howard, and *Trichogrammatomyia* Girault. The North American species of *Trichogramma* can be identified by means of the keys provided by Nagarkatti and Nagaraja (1971) and Nagaraja and Nagarkatti (1973). Pinto et al. (1978) reexamined the types and made redescriptions of species of the common trichogrammatids in North America.

Unlike the other families of Chalcidoidea, the Trichogrammatidae are classified largely on the male genitalia, especially in members of the genus *Trichogramma*, on which more papers have been published than any other group of chalcidoids. Doutt and Viggiani (1968) published a monograph of the 70 world genera of Trichogrammatidae with a key and a list

of all known species. Viggiani (1971) divided the family into two subfamilies, with two tribes under each subfamily, Trichogrammatinae (Trichogrammatini, Paracentrobiini) and Oligositinae (Chaetostrichini, Oligostini), based on characters of the male genitalia. He has provided a key to 27 of the 70 known genera. Because of the minuteness and the degree of specialized work needed for this group, it seems best to place the entire group under one family for the purpose of this manual.

Among the trichogrammatids, as in other groups of chalcidoids, some species show a certain degree of host specificity, whereas others show very little specificity. All members of this family, however, are parasitic on eggs of other insects. Examples are *Oligosita* Walker and *Paracentrobia* Howard on Cicadellidae (Homoptera) and Lestidae (Odonata); *Hydrophylita* Ghesquière on Oenagrionidae (Odonata); *Trichogramma* Westwood on many different hosts; *Trichogrammatomyia* Girault on Lepidoptera; *Aphelinoidea* Girault on Cicadellidae (Homoptera).

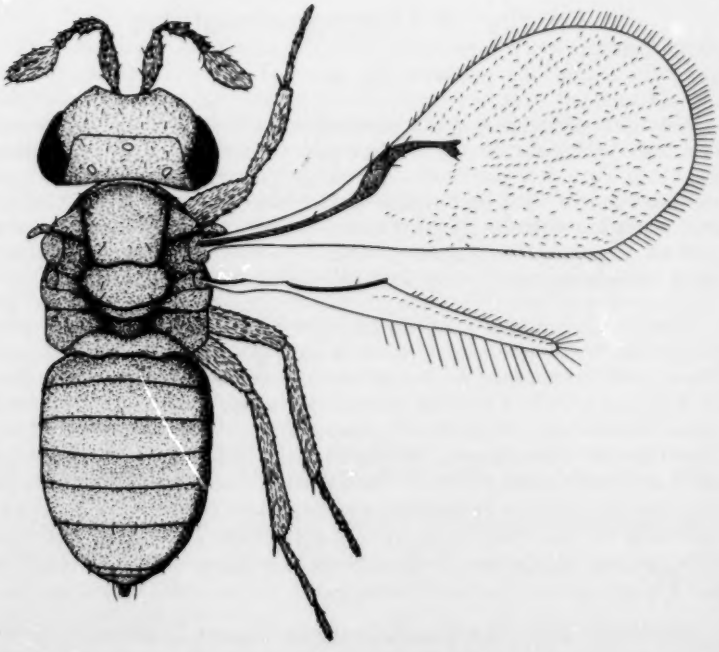

Fig. 86. Family 14 Trichogrammatidae: female *Trichogramma* sp.: dorsal view of habitus.

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Family 15 Mymarommatidae

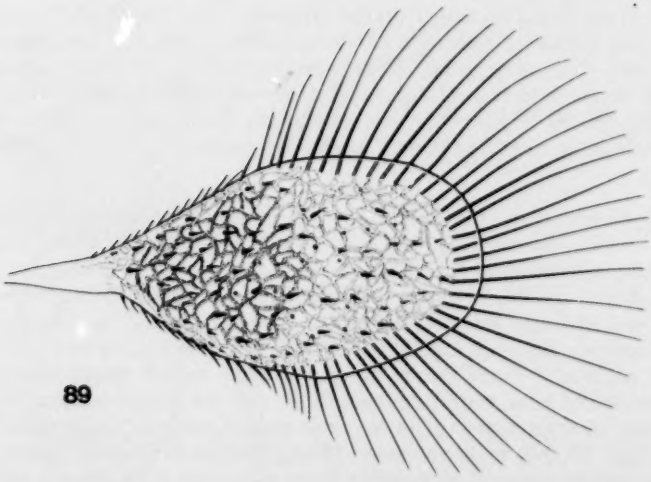
Figs. 87–91

Members of the family Mymarommatidae are slender, delicate, and very tiny, ranging from 0.35 to 0.64 mm long. The family is well represented in the fossil record from the Oligocene and Miocene (Yoshimoto 1975) and Mesozoic (Schlüter 1978), but both species and specimens are rare today. Only nine species have been described throughout the world, and all occur in the single genus *Paleomymar* Munier. *Paleomymar* spp. (Figs. 87–89, 90, 91), are known from North America, but only the latter species as yet is recorded from Canada (Gibson and Yoshimoto in preparation).

Members of the family Mymarommatidae are easily recognized by the following characters: Wing pedunculate, with disc wide, entirely reticulate, surrounded by extremely long marginal cilia that arise from within disc (Figs. 89, 91). Petiole 2-segmented (Fig. 87). Head lenticular, composed of single sclerite, without sutures or carinae; antennal toruli close together, inserted high at the level of dorsal eye margin of head and widely separated from inner margin of eyes; mouth cavity occupying entire width of head, with large mandibles not meeting at midline; female antennae 10-segmented (in all Nearctic forms), without longitudinal sensoria (Figs. 88, 90); male antennae 13-segmented. Prepectus absent; pronotum greatly reduced, not visible from above but propleura large (Fig. 87); mesopleuron large, without impressed lines or sutures, but flat, inflated; metapleuron large, fused with propodeum. Tarsi 5-segmented; fore tibial spur simple, nonstrigulate, at most slightly curved. A more complete family description is given by Debauche (1948) and by Gibson and Yoshimoto (in preparation).

87

88



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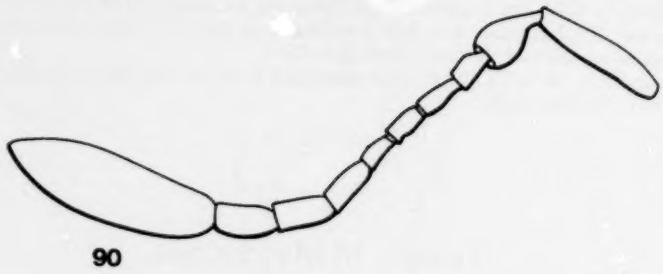
Figs. 87–89. Family 15 Mymarommatidae: female species: 87, lateral view of habitus; 88, antenna; 89, fore wing.



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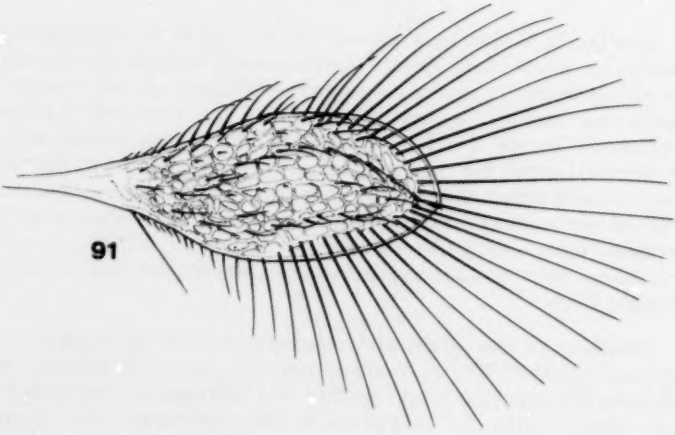

91

Figs. 90, 91. Family 15 Mymarommatidae: female species: 90, antenna; 91, fore wing.

The biology of this family is not known, though species probably are egg parasites.

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Family 16 Mymaridae

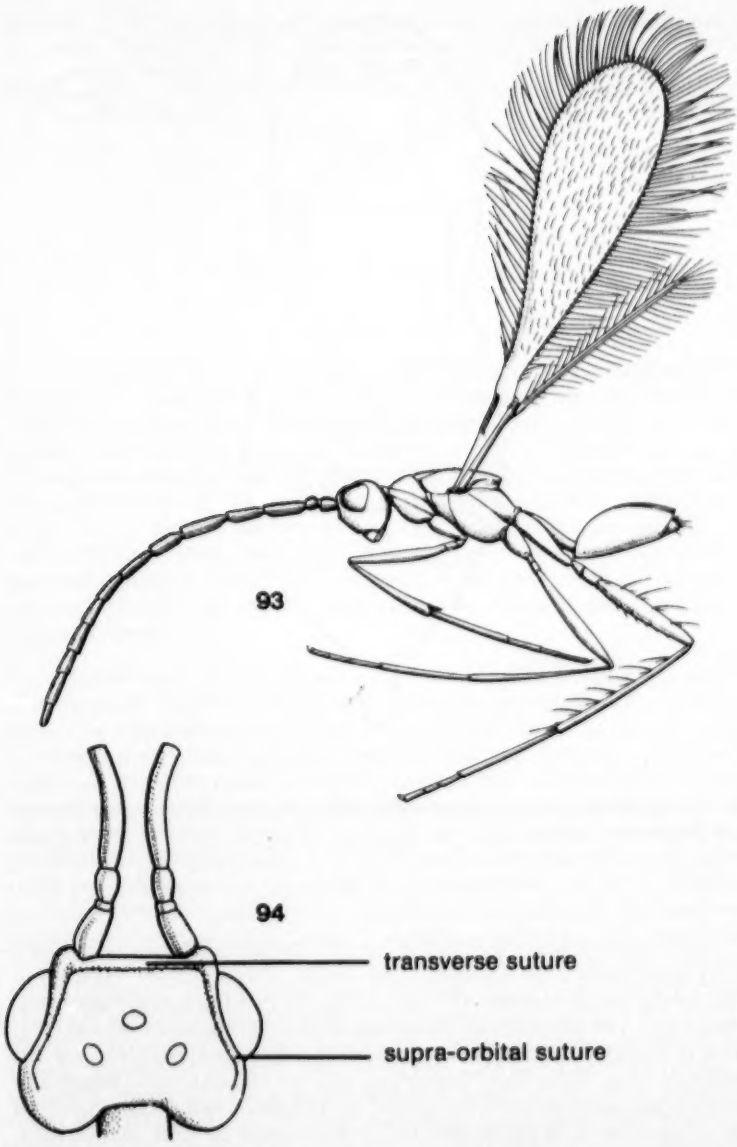
Figs. 92–95

The family Mymaridae is an unusual group in the superfamily Chalcidoidea. In some fossil species the pronotum reaches the tegulae (as in Proctotrupoidea). In most extant species the antennal toruli are far apart, usually near the eye margin. However, in the subfamily Eubroncinae (Yoshimoto, Kozlov, and Trypitsin 1972), which is not present in Canada, the antennal toruli are on a projection from the middle of the face and closer to each other than to eye margin. The larvae are similar to the scelionid larvae (Nikol'skaya 1952). Yoshimoto (1975) postulated that the mymarids have evolved independently from the primitive eurytomid–torymid ancestor group and before the pteromalid and tetracampid–eulophid lines.

Members of this family are recognized by the following characters: Size usually 0.35–2.00 mm. Body nonmetallic, generally slender, delicate, with long thin antennae and legs (Fig. 93). Dorsum of head with 2 sets of sutures and a carina, 1 strong prominent transverse suture (= transverse trabecula) between inner orbits of eyes dorsad of antennal toruli, 1 pair of frontal carinae extending from extremities of transverse suture ventrally along inner orbits of eyes, and 2 supra-orbital sutures (= supra-orbital trabeculae) extending from extremities of transverse suture dorsally toward posterior part of head (Fig. 94). Transverse and supra-orbital sutures of vertex folded along the margins of head sclerites, and sometimes appearing as carinae or striations; folded margin of sclerite often obscuring view of suture from above. Wings usually long and narrow, often with long marginal fringe of setae (Fig. 93), and always with greatly reduced venation in fore wings; venation usually restricted to basal third of wing where marginal vein short or absent; stigmal and postmarginal veins usually absent or vestigial (Fig. 93); fore and hind wings pedunculate (stalked). Antennae long and slender in both sexes, 8–13-segmented, without anelli (Figs. 93, 95); male antennae filamentous (Fig. 93); female antennae with distinct club (Fig. 95), 1–3-segmented, with longitudinal sensoria (usually obscure unless slide-mounted); toruli much nearer to eyes than to each other (Fig. 94). Legs often long and thin in relation to body (Fig. 93), with tarsi 4- or 5-segmented; frontal tibial spur long, curved, bifid, forming a well-developed strigil.

Fig. 92. Family 16 Mymaridae, subfamily 2 Mymarinae: female *Anagrus* sp.: dorsal view of thorax and gaster.

There are two main systems of higher classification of the Mymaridae, as exemplified by Annecke and Doutt (1961) and by Peck et al. (1964). In the former system the mymarids are divided into the subfamilies Alaptinae and Mymarinae, based on whether the gaster is sessile (Fig. 92) (tribes Anagrini, Alaptini) or subsessile (tribes Anaphini, Ooctonini) to petiolate (Fig. 95) (tribe Mymarini), and on the extent to which the mesophragma projects into the gaster. In the latter system the family is divided into the Gonatocerinae (= Lymaenoninae) and Mymarinae, based on whether the tarsi are 4- or 5-segmented. In both systems tribal categories are used, which are based on the major character for subfamily separation in Annecke and Doutt's (1961) classification. For this manual I am following the system of Ashmead (1904), Debauche (1948), Nikol'skaya (1952), Bouček (*in* Peck et al. 1964), and Schauff (1983).



Figs. 93, 94. Family 16 Mymaridae, subfamily 2 Mymarinae: male *Polynema* sp.: 93, lateral view of habitus; 94, dorsal view of head.

Fig. 95. Family 16 Mymaridae, subfamily 2 Mymarinae: female *Polynema* sp.: lateral view of habitus.

A detailed study of the anatomy of the Mymaridae is given by Debauche (1948), and a key to the genera of the world is given by Annecke and Doutt (1961). Schauff (1983) included 22 valid genera for the Holarctic region, with synonymy, phylogeny, generic diagnoses, morphology, and key to genera. Graham (1982) examined and identified all of Haliday's collection of Mymaridae, with redescriptions and comments on each of the types. A key to the genera of the New World Mymaridae is given by Yoshimoto [1984] (in preparation).

Members of this family are almost all internal primary egg parasites of a wide variety of insects. Although often poorly represented in collections because of their small size, mymarids are worldwide in distribution and very common. Because of their small size, specimens in most instances should be permanently mounted on glass slides for study.

Key to subfamilies of Mymaridae

1. Tarsi 5-segmented ..... **Gonatocerinae** (p. 134)
   Tarsi 4-segmented ..... **Mymarinae** (p. 135)

Clé d'identification des sous-familles des Mymaridæ

1. Tarses de 5 articles ..... **Gonatocerinæ** (p. 134)
   Tarses de 4 articles ..... **Mymarinæ** (p. 135)

Subfamily 1 Gonatocerinae

The characters of the subfamily are given in the key to subfamilies and in the family diagnosis of Mymaridae.

All genera within this subfamily possess a simple antennal club (except *Eustochomorpha* Girault, which is not known from North America). Nine genera are represented in North America, of which *Dicopus* Enock, *Macrocamptera* Girault, *Litus* Haliday, *Alaptus* Westwood, *Arescon* Walker, *Camptoptera* Förster, *Gonatocerus* Nees, and *Ooctonus* Haliday have been recorded from Canada.

The members of the genus *Gonatocerus* parasitize species of Coleoptera, Hemiptera, and Homoptera. The species of *Ooctonus* are known to parasitize Hymenoptera. The members of the genus *Alaptus* parasitize psocids (Psocoptera); the genus *Litus* is associated with Staphylinidae (Coleoptera); and the species of *Camptoptera* are parasites of Buprestidae (Coleoptera), Cicadellidae (Homoptera), and Thripidae (Thysanoptera).

Subfamily 2 Mymarinae

The characters of the subfamily are given in the key to subfamilies and in the family diagnosis of Mymaridae.

The antennal club is 1–3-segmented. Fourteen genera are represented in North America, of which *Anagrus* Haliday, *Cleruchus* Enock (= *Paracleruchus* Yoshimoto 1971, *sensu* Viggiani 1974), *Anaphes* Haliday, *Erythmelus* Enock, *Omyomymar* Schauff, *Eustochus* Haliday, *Chaetomymar* Ogloblin, *Stephanodes* Enock, *Acmopolynema* Ogloblin, *Mymar* Curtis, *Caraphractus* Walker, and *Polynema* Haliday have been recorded from Canada.

Gordh (1977) revised the genus *Anagrus* with five species for North America.

In the Mymarinae, the species of *Anagrus* are parasites of Hemiptera, Homoptera, Lepidoptera, and Diptera; species of *Cleruchus* parasitize members of Coleoptera; species of *Anaphes* (*Patasson*) parasitize Coleoptera and Hemiptera; *Mymar* parasitizes Coleoptera, Hemiptera, Homoptera, and Lepidoptera; species of *Polynema* parasitize the members of Odonata, Coleoptera, Homoptera, Diptera, and Hymenoptera; *Chaetomymar* parasitizes Cicadellidae (Homoptera) and Lyonetiidae (Lepidoptera); *Acmopolynema* parasitizes Acrididae (Orthoptera); and *Erythmelus* parasitizes Cicadellidae (Homoptera), and Tingidae and Miridae (Hemiptera).

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Glossary

admarginal hairs Single row of setae below and parallel with marginal wing vein.

anellus (pl., **anelli**) One or more antennal segments lying between pedicel and funicle segment that are either tiny, vertically flattened, or shorter and narrower than funicle segment.

antenna (pl., **antennae**) Paired segmented sensory organs.

antennal torulus (pl., **antennal toruli**) The membraneous area of the cranial wall, strengthened by a marginal ridge, in which the antenna is attached.

anterior ocellus Frontal simple eye.

apodeme Hollow conical sclerite, pit, furrow, slight swelling, or ridge that serves as point of attachment for the muscles.

apterous Without wings.

arcuate Arched, or bowlike.

axilla (pl., **axillae**) Two small subtriangular sclerites at lateral base angles of mesonotum.

axillula (pl., **axillulae**) Two small subtriangular sclerites laterad of scutellum and posterior to axillae.

basal vein A diagonal vein usually replaced by a row of hairs below parastigma near the base of the wing.

basitarsus The first segment of a tarsus.

brachypterous Wings rudimentary or abnormally small.

bidentate Having two teeth.

bristle Short, stiff, coarse hair.

callus A lateral area of propodeum between propodeal spiracle and lateral edge.

carina A longitudinal narrow ridge.

cercus (pl., **cerci**) A small piliferous process on lateral tergum 7 (or sing. pygostylus), usually with two or three long setae.

club Enlarged distal segment or segments of antenna.

clypeus A sclerite below the face bounded by the epistomal suture and with tentorial pits at its dorso-lateral corners.

compound eye Large lateral multifaceted organ of sight on the head.

conical Pertaining to a cylindrical shape, with a flat base tapering to a point.

cornute Pertaining to a hornlike process.

costula (pl., **costulae**) A narrow ridge, or carina, running transversely across middle of propodeum.

coxa (pl., **coxae**) Basal segment of a leg that is articulated to the body.

crest A prominent longitudinal carina.

crescentic Pertaining to a semicircular shape.

cubital vein A longitudinal vein of the fore wing, lying between medial and anal veins.

dentate Pertaining to a toothlike structure.
disc A central area of the wing.
dorsellum A subcrescentic, or ribbonlike, sclerite of the mesonotum, lying in front of the propodeum.

epistomal suture A transverse suture between the anterior tentorial pits separating the clypeus from the face (= frontoclypeal suture).
epipygium The dorsal arch of the last gastral segment.

face Area between antennae and clypeus.
femoral groove An oblique depression between mesepimeron and mesepisternum of thorax.
flagellum Antennal segments beyond pedicel.
frenal groove Groove separating posterior part of scutellum.
frenum The posterior part of scutellum separated by a transverse frenal groove.
frontal carina Carina extending from extremities of transverse suture ventrally along orbits of eyes.
frontal fork Y-shaped suture located between anterior ocellus and toruli.
frons Area between anterior ocellus and antennal socket bounded by the compound eyes.
funicle Part of antennal flagellum between the apical club and anelli.

gaster The part of the body beyond gastral petiole or propodeum.
gena (pl., **genae**) Cheek, or the part of the head on each side of face below the eyes, extending forward to tentorial pits.
glabrous Smooth, hairless, and without punctures or other structures.
gonotergite The "outer plate," or modified transparent remnant, of the ninth tergum enclosing the ovipositor sheath, or gonostylus.

habitus Used comparatively to express a resemblance in general appearance.
hyaline Transparent or nearly so.
hypopygium Pertaining to the lower plate of the anal opening.

inner orbit Anteromedian border of compound eye.
interantennal crest A prominent subtriangular carina between toruli.

lateral ocellus One of the two posterior simple eyes.
laterotergite A lateral sclerotization of tergite from a principal median tergite; paratergite.

malar groove Groove lying between ventral margin of compound eye and base of mandible.
malar space Pertaining to an area on each side of the head between the proximal end of the mandible, the ventral margin of the compound eye, and the posterior part of gena.
mandible One of a pair of stout toothlike structures in insects, used for chewing cutting.

marginal vein Part of subcostal vein in contact with anterior margin between submarginal vein and emergence of stigmal vein.
median carina Longitudinal narrow ridge along middle of propodeum.
membraneous Thin semitransparent pliable part of exoskelton.
mesepimeron Posterior-lateral sclerite of mesothorax.
mesepisternum Anterior-lateral sclerite of mesothorax.
mesonotum The upper surface of the mesothorax.
mesophragma An internal prolongation of the metanotum affording attachment to some of the wing muscles.
mesopleural suture A suture on each side of the body separating the episternum and the epimeron of mesothorax.
mesopleuron Lateral surface of mesothorax.
mesoscutum Anterior-dorsal part of the mesothorax.
mesosoma Collective term for the thorax and propodeum.
mesothorax The second, or middle, thoracic segment, which bears the middle legs and fore wings.
metanotum Dorsal aspect of the third, or posterior, section of metathorax.
metapleural suture Suture on each side separating the episternum and epimeron of metathorax.
metapleuron Lateral surface of metathorax.
metathorax Third, or posterior, thoracic segment, which bears the hind legs and hind wings.
metepimeron Posterior-lateral sclerite of metathorax.
metepisternum Anterior-lateral sclerite of metathorax.

notaulus (pl., **notauli**) A paired longitudinal furrow, the two parts of which converge posteriorly and separate the middle from the lateral lobes of the mesonotum.
nucha A part of the posterior region of the propodeum where the petiole attaches to the gaster.

occipital carina A transverse keel or elevated ridge situated between the vertex and the tentorial pits of the head.
ocellar-ocular line (OOL) Distance between posterior ocellus and inner margin of the eye.
ocellus (pl., **ocelli**) A simple eye, with a single beadlike lens (one of three on the vertex of head).
ovipositor A valved egg-laying structure either concealed in the gaster or extended beyond the apex of gaster of female.

paramedial Area next to the middle.
parastigma The enlarged distal part of the submarginal vein where it connects to the marginal vein.
paratergite A lateral sclerotization of the dorsum distinct from a principal median tergite; laterotergite.
pedicel The second segment of the antenna, which lies between the scape and the flagellum.

pedunculate With a slender stalk or necklike process.
percurrent Running through the entire length; continuous.
petiole A stout or slender stem between propodeum and gaster.
phragma An internal ridge, or flange, to which muscles are attached.
plica (pl., **plicae**) A longitudinal ridge, or carina, sublaterally on propodeum, extending from the posterior petiolar emargination to either the spiracle or the anterior margin.
plumate Featherlike, with filamentous or hairlike projection from a central stalk.
postocellar line (POL) Distance between posterior ocelli.
posterior ocellus (pl., **ocelli**) One of the posterior pair of three simple eyes on vertex of head.
postmarginal vein The sclerotized rodlike structure of the fore wing beyond the marginal and stigmal veins.
prepectus A sclerotized plate along the anterior margin of the episternum of mesothorax adjacent to pronotum.
pronotum Dorsal sclerite of the prothorax.
propodeum The first abdominal segment or the part of that sclerite joining the metanotum anteriorly and the petiole posteriorly.
prothoracic spiracle Spiracle situated laterally on the hind margin of pronotum.
prothorax First thoracic segment, which bears the anterior legs.
pygostylus (pl., **pygostyli**) A small piliferous process on lateral tergum 7 (or sing. cercus), usually with two or three long setae.

radial cell Anteroapical area of wing between postmarginal and stigmal veins.
reticulate A network of line in a hexagonal arrangement.
rugose Coarsely wrinkled.
rugulose Finely wrinkled.

scape The long basal segment of antenna.
sclerite A hard plate.
sclerotize To harden and darken through tanning of proteins.
scrobe A groove, or cavity, on the frons formed for the reception or concealment of the antennal scape.
sublateral grooves Longitudinal furrows on the scutellum.
submarginal vein A basal stemlike part of the subcostal vein enclosing the costal cell.
scutellum A sclerite forming the posterior part of the mesothorax just behind the mesoscutum.
scutum (pl., **scuta**) A sclerite covering part of the notum.
segment A subdivision of the body or of an appendage between areas of flexibility.
serrate Sawlike.
sessile Attached directly, not raised on a base, e.g., gaster broadly attached to the thorax.
seta (pl., **setae**) A slender hair.

speculum A transparent area, or spot, on the wing adjacent to basal vein and distad of submarginal vein.
spiracle A breathing pore, or opening, on the insect body through which air enters the trachea.
sternite Ventral sclerite.
sternum (pl., **sterna**) Ventral part of the insect thorax between coxal cavities.
stigma The enlarged distal part of stigmal vein.
stigmal vein A radial cross vein or the part of a vein extending into disc of wing distad of marginal vein.
stria (pl., **striae**) A fine, longitudinal, impressed line.
strigil A curved, comblike, movable spur on the distal end of fore tibia.
strigulate Having numerous fine, short, transverse lines.
supra-orbital suture Suture extending from extremities of transverse suture toward posterior part of head.
suture A seam, or impressed line, indicating the division of distinct parts of the body wall.

tarsus (pl., **tarsi**) The "foot," or jointed appendage at the apex of the tibia, bearing the claws and tarsal pads.
tergite A dorsal sclerite.
tegula (pl., **tegulae**) A non-articulated lobe above base of first articular sclerite (first axillary plate).
temple Part of the vertex adjacent to the eyes.
tergum (pl., **terga**) A dorsal surface of gastral body segment.
tibia (pl., **tibiae**) Apical division of the leg.
tibial spur A spine at ventro distal end of the tibia.
torulus (pl., **toruli**) See antennal torulus.
transcutal suture Pertaining to a furrow between mesoscutum and scutellum of the mesothorax.
trabecula A basal mass of fibers situated within the cellular envelope.
transverse Broader than long.
transverse suture Suture between orbits of eyes dorsad of antennal toruli.
trochanter One or two small segments lying between the coxa and the femur.

umbilicate Navellike.
uncus A curved hooklike structure on the stigmal vein.

venation The complete system of veins of a wing.
venter Undersurface as a whole.
ventrad In direction of the venter.
vertex The top of the head between eyes, frons, and occiput.

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